

## CHAPTER 4

### NEXT-GENERATION VEHICLES AND FUELS

Transportation vehicles are a major element of our transportation system. In fact, transportation's performance, safety, security, cost, environmental impact, economic consequences, and contributions to quality of life are all determined largely by the vehicles that carry people and goods. Today, our transportation system faces several major challenges that are directly related to vehicles and fuels: increased global competition for our transportation industries, economic exposure to fuel price instability, attainment of the National Ambient Air Quality Standards (NAAQS), reduction of greenhouse gas (GHG) emissions, and increased demands for mobility from our citizens. Meeting these challenges will require a next generation of vehicles and eventually, fuels, that meet rigorous standards for reliability, cost, safety, energy use, and environmental impacts. Thus, a strategic goal for transportation R&D is enhancing the overall performance of vehicles of all types, while expanding the range of available alternatives.

Unlike physical infrastructure improvements, a large number of which the Government is responsible for, vehicle technology improvements are achieved through long-term R&D that optimizes and leverages the use of both public and private resources. Federal investment is needed to reduce the risk to the private sector and to assure a continuous flow of innovation.

In its Strategic Planning Document for 1995, the NSTC Committee on Transportation R&D identified a number of major program objectives for transportation vehicle R&D. Among these are the following:

- *Develop a personal motor vehicle that will deliver up to three times the fuel efficiency of today's comparable vehicles while reducing emissions, without compromising performance, safety, room, and utility.*
- *Develop and introduce manufacturing technologies and practices that will reduce the time and cost associated with designing and mass-producing this new personal motor vehicle.*
- *Improve and regain the U.S. position in the world truck and bus market.*
- *Assure that advanced truck and bus technologies consider accessibility, energy efficiency, and environmental impacts.*
- *Facilitate innovation in rail vehicle design and construction by introducing advanced materials, communications, and control technologies.*

- *Improve the propulsion and emission performance of intercity and commuter locomotives, and expand the range of alternatives available to meet future transportation needs.*
- *Develop strong and competitive international ocean shipping and domestic water transportation industries.*
- *Develop a strong and competitive commercial ship design and production capability.*

### ***Near-Term Efforts***

The majority of DOT's near-term vehicle research is aimed at meeting the transportation committee's objectives. Specific programs are discussed below:

#### ***Motor Carrier Research (FHWA)***

FY	1997	1998	1999
Funding	7,399	8,541	NA
FTE	9	9	NA

The Office of Motor Carriers' (OMC) research program includes the following: (1) human factors research on commercial driver alertness, medical fitness, drug and alcohol use, and driver licensing and training (discussed in Chapter 5, below); (2) evaluation and promotion of safety-enhancing vehicle and data-reporting technologies; (3) establishing and undertaking program analysis activities; (4) undertaking a comprehensive, multiyear regulatory review to make regulations more enforceable, understandable, and performance-based; and (5) creating more opportunities for innovation, partnerships, and shared financing in the pursuit of OMC research objectives. Non-driver-related OMC research includes:

- Technology — Review ITS technologies to determine near-term applications for improving motor carrier safety and productivity. Determine the effectiveness of various technologies and their impact on the operations of multiple-trailer commercial vehicles. In coordination with NHTSA, assess feasibility of alternative braking technologies (e.g., electric), as well as recommendations for the marking and identification of commercial motor vehicle replacement parts and accessories. Assess the feasibility of standards for "after market" brake linings and other brake system components.
- Information Analysis — Implement a system to improve the validity and reliability of information in the motor carrier Census File update. Analyze the effectiveness of fines and penalties, as well as technical assistance and education programs, in achieving motor

carrier and driver compliance with safety regulations. Evaluate the characteristics of reported crashes by different motor carrier operations, vehicle types, crash locations, and other pertinent factors.

- Services and Partnerships — Continue efforts to develop and implement new, cost-effective reporting, recordkeeping, and registration procedures.
- Creating more opportunities for innovation, partnerships, and shared financing in the pursuit of its research objectives.

Major milestones for FY 1998 will include the identification of potential technologies for rapid and reliable roadside inspection activities, and the development of an effective interface between SAFETYNET and ITS data systems.

*Safety Systems (NHTSA)*

FY	1997	1998	1999
Funding	6,488	8,338	NA
FTE	16.01	16.02	NA

Frontal, side, and rollover crashes account for most of the deaths and injuries to occupants of passenger cars and light trucks and vans. Ejections, pedestrian impacts, and fires also cause death and injury. The goal of this research is to provide improvements in vehicle structure and occupant compartment design, in combination with improvements in restraint systems. These improvements require research in test procedures, injury likelihood measurement, and countermeasure development and evaluation. A second goal is to foster international harmonization in the pedestrian, frontal offset, vehicle compatibility, and functional equivalence research areas, including the following:

- Evaluating the reliability of rollover test procedures.
- Analyzing the feasibility of modeling the early phase of air bag deployment.
- Continuing to update and maintain the vehicle attributes crashworthiness database.
- Continuing to test various impact configurations.
- Evaluating designs of modified vehicles to establish the effectiveness of side-impact countermeasures.
- Using the developed seat model, investigate countermeasures that would mitigate whiplash and other injuries.

- Continuing work on a near-term, economical crash sensor to reduce occupant injuries.
- Continuing R&D on advanced air bag systems.

A milestone for FY 1998 will be to evaluate production vehicles and develop countermeasures for improved frontal crash protection.

*Biomechanics (NHTSA)*

FY	1997	1998	1999
Funding	7,437	10,587	NA
FTE	8.54	8.54	NA

Within the framework of the newly established National Transportation Biomechanics Research Center, biomechanical research efforts will continue to build on the program of increasing our biomechanical understanding of the impact injuries and developing technologies that will reduce impact injuries on the Nation's highways. These efforts will expand the Department's expertise and capability in the area of impact biomechanics, improve and promote the use of biomechanics in all transportation modes, as well as adapt this technology to impact safety efforts within both the civilian and military sectors. NHTSA's Biomechanics research program pursues efforts that (1) study physical conditions and human consequences of real-world crashes with multidisciplinary teams of medical, engineering, and crash investigation professionals; (2) provide a detailed understanding of the forces, motions, and distortions the human body experiences in a crash and their relationship to the extent and severity of resulting injuries; (3) create detailed computer models of the human body that can simulate human impact response and trauma; and (4) develop and improve dummy components and other mechanical trauma assessment devices that evaluate human impact risk. Ongoing efforts include:

- Conducting hospital-based, in-depth crash injury studies at four trauma centers.
- Continuing experiments to increase public safety with better seat belt and air bag systems.
- Conducting experiments to increase public protection in side impacts.
- Continuing experiments to determine neck trauma and validate neck computer model.
- Continuing to develop human thorax computer model.
- Continuing upgrading and updating of existing crash dummies.
- Studying brain trauma resulting from crashes.

A major milestone for FY 1998 will be computer linkage of detailed hospital-based injury studies completed and on-line. Efforts of existing centers coupled with efforts of additional three centers maintained by independent funding. Applicability of research in biomechanics to multiple modes will be actively pursued by NHTSA.

*Partnership for a New Generation of Vehicles  
(NHTSA)*

FY	1997	1998	1999
Funding	2,496	2,496	NA
FTE	0.00	0.00	NA

This NHTSA program provides technical support for the Administration's Partnership for a New Generation of Vehicles (PNGV) initiative. As the focal point within DOT for the PNGV program, the goal of the research is to ensure that the PNGV-developed vehicles will meet existing and anticipated safety standards and that the overall crash and other safety attributes are not compromised by their light weight or use of new advanced materials used in production of these vehicles. Ongoing work will:

- Continue to develop advanced computer models to evaluate the crashworthiness of conceptual designs.
- Continue research in the area of lightweight materials such as advanced composites. Develop new, unique material models for use in the FEM code.
- Provide the required PNGV transportation infrastructure analyses.
- Provide peer review study of the conceptual designs.

A key FY 1998 milestone will be to continue to develop analytical capability to support the PNGV program.

*Heavy Vehicles (NHTSA)*

FY	1997	1998	1999
Funding	595	595	NA
FTE	7.47	7.48	NA

The goals of this research effort are to reduce the Nation's health care costs by improving heavy vehicle crash avoidance and crashworthiness capabilities, e.g., better braking, enhanced dynamic stability and improved occupant crash protection. Heavy vehicles constitute 3 percent of the vehicle population, accumulate 7 percent of the vehicle miles traveled, but are involved in 13 percent of all fatal crashes. Most of these fatalities (approximately 4,000 each year) are occupants of smaller vehicles involved in collisions with heavy trucks. This represents more

than 25 percent of the light vehicle occupants who are killed annually in two-vehicle collisions. Near-term research includes the following:

- Complete a cooperative program with industry to develop braking stability performance test procedures for air-braked trailers in support of rulemaking.
- Expand joint efforts with industry to develop information and data needed by government and manufacturers to further improve truck safety performance through the use of electronic braking.
- Continue feasibility assessment of methods for reducing the severity of truck/car frontal collisions.
- Continue to foster the application of advanced technology to improve the collision avoidance performance of heavy vehicles.

An FY 1998 milestone will be to complete evaluation of test procedures to measure friction properties of heavy vehicle brake linings.

*Equipment, Operations, and Hazardous Materials Research (FRA)*

FY	1997	1998	1999
Funding	5,545 <sup>13</sup>	5,509 <sup>14</sup>	NA
FTE	5	5	NA

This FRA program is designed to improve safety and enhance productivity within the railroad industry by reducing accidents caused by unanticipated and catastrophic equipment failure, inefficient or ineffective operations, and the inadvertent release of hazardous materials.

Current activities, which emphasize technologies to identify defects well before failure and to ensure safe operations at higher speeds, include the following:

- Equipment - Evaluating wheel stress nondestructive evaluation (NDE) techniques; completing “end user” development of a wheel defect detection device; validating the performance specifications of advanced braking systems; completing the preliminary analysis of cab car crashworthiness; and completing the preliminary dynamic performance specifications of conventional passenger vehicles.

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<sup>13</sup>Includes \$2,000k for FRA *Human Factors* research.

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- Hazardous Materials - Completing studies on tank car/lading compatibility; completing Phase I of the stub sill fatigue crack growth study.

Major FY 1998 milestones will include:

- Publication of results of evaluation of an improved roller bearing wayside inspection method.
- Publication of the tank car 15,000 mile service loads measurement report.

*Safety of High-Speed Ground Transportation  
(FRA)*

FY	1997	1998	1999
Funding	4,600	5,250	NA
FTE	1	1	NA

The goals of this FRA program are to provide validated technologies and data bases to support FRA rulemaking related to high-speed rail safety; to develop new inspection technologies to monitor the safety performance of high-speed passenger rail equipment; and to provide an knowledge base for public and private decision making related to high-speed rail systems.

Current research efforts include:

- Developing crash energy management concepts for occupant protection.
- Assessing the adequacy of track strength under loads from high cant deficiency (tilt) operations.
- Evaluating the actual safety performance of prototype high-speed positive train control systems.

Major milestone for FY 1998 will include:

- Providing technical evaluation of the Florida/FOX high-speed rail system and technical support to the Amtrak high-speed trainset under development.
- Updating fire safety guidelines and evaluation methods.
- Completing passenger seat impact test and evaluation.

*Next-Generation High-Speed Rail (FRA)*

FY	1997	1998	1999
Funding	26,176	19,595	NA
FTE	4	4	NA

This FRA program's goal is to develop, demonstrate, and validate cost-effective high-speed (125-150 mph) passenger rail technology that operates on existing infrastructure in the U.S., to reduce per-mile upgrade costs from about \$10 million to \$2-3 million, and to make proven high-speed rail technologies available to States for implementation by the year 2000. Current research activities include:

- Non-Electric Locomotives - Demonstrating the operating and maintenance characteristics of new locomotive designs; demonstrating the operability of flywheel energy storage in the laboratory; testing active locomotive noise control.
- Planning Technology - Updating and integrating user-friendly high-speed rail operational and economic performance computer forecasting models for State planning.

For FY 1998, key milestones will be include:

- Incorporating flywheel system into a locomotive and preparing for testing.
- Evaluating revenue service performance of advanced nonelectric locomotives in one or more corridors.

*Shipyard Revitalization (MARAD)*

FY	1997	1998	1999
Funding	0	0	NA
FTE	NA	NA	NA

This program addresses the implementation and execution of President Clinton's Plan entitled "Strengthening America's Shipyards: A Plan for Competing in the International Market." In support of this initiative, the Congress enacted legislation on November 30, 1993, containing the National Shipbuilding Initiative (NSI). This legislation serves as a catalyst for promoting construction of ships in U.S. shipyards as part of the transformation from a primarily military focus to one serving the international commercial marketplace. Goal 3.7 of the DOT's Strategic Plan commits the Department to "Implement the President's new shipbuilding initiative to enable American shipbuilding to be more competitive globally." As the U.S.



Government's commercial shipbuilding advocate, the Maritime Administration is undertaking the initiatives identified in the President's program. These are:

- Ensuring Fair International Competition
- Improving Competitiveness
- Eliminating Unnecessary Government Regulation
- Financing Ship Sales through Title XI Loan Guarantees
- Assisting International Marketing

An important milestone for FY 1998 will be to continue the implementation of these National goals. The full implementation of the mission of the Maritime Administration's National Maritime Resource and Education Center will provide the industry with: a coordinated administration of MARAD MARITECH funded projects designed to improve shipbuilding processes and the development of new and improved ship designs; support for U.S. efforts at reaching consensus on domestic and international standards and regulations affecting the competitiveness of the U.S. maritime industry; access to comprehensive Marine Standards and International Standards Organization (ISO) 9000 and 14000 information; and MARAD sponsored topical seminars, training and other resource support as requested by the industry.

Given sufficient funding, another element for consideration is the Ship Structure Cooperative Research Program. The goals of this cooperative research program are to investigate ship structural problems, pursue new technology, and develop structural design, analysis and fabrication techniques in areas of common interest. The research is defined and directed by the Ship Structure Committee with assistance from the Committee on Marine Structures, Marine Board of the National Research Council. The Ship Structure Committee is jointly funded by participating agencies, which include the Maritime Administration, the U.S. Coast Guard, the Military Sealift Command, the U.S. Navy, the American Bureau of Shipping, Transport Canada, and the Canadian Defense Research Establishment. MARAD is unable to contribute funds in 1997, but has been allowed to continue to participate in the Cooperative's program decision making process.

Key milestones for the Ship Structure Cooperative Research Program include: the completion of research on hull monitoring systems, visual detection of structural defects, weld repair adequacy, corrosion control during fabrication and improved fatigue life of weld details; and the awarding of contracts for new research in the Ship Structures Cooperative Research Program as chosen by U.S./Canadian government participants.

*New Bus Vehicles and Infrastructure (FTA)*

FY	1997	1998	1999
Funding	6,500	11,000	NA
FTE	NA	NA	NA

This FTA program aims to improve the safety, service, and cost-efficiency of public transportation through research and adoption of new technology, management practices. The program also emphasizes the introduction and safe use of alternative fuel buses. The program will develop and demonstrate new vehicles and vehicle technologies that significantly lower operating and maintenance costs and improve air quality, and will foster the commercialization of these new technologies. FY 1998 program activities include the following:

- Complete prototype construction and field testing of the Advanced Technology Transit Bus (ATTB), initiate work on development and deployment of advanced technology subsystems for transit buses, and provide engineering support for the new bus model testing program in Altoona. The ATTB utilizes light-weight materials, advanced structural design, and new passenger information systems and electronics and consumes less fuel, thus lowering operating costs. The ATTB will also meet clean air emission standards, and its no-steps, low-floor design will provide improved access to persons with disabilities.
- The Demonstration of Universal Electric Subsystems (DUETS) program is developing and testing an advanced alternatively fueled electric-hybrid drive system, advanced suspension components, and advanced vehicle control networks for transit bus applications. The resulting technologies will provide ultra-low emissions along with improved vehicle handling and interfaces with intelligent transportation systems (ITS). FTA will encourage further adaptation of electrical hybrid technologies developed by the DUETS program for wide application in electric and hybrid electric vehicles for meeting Clean Air Act and Americans With Disabilities Act requirements.

*Advanced Bus Propulsion Systems (FTA)*

FY	1997	1998	1999
Funding	9,500	8,000	NA
FTE	NA	NA	NA

This program's goals are fourfold: develop and demonstrate a low- and zero-emission propulsion system for transit vehicles with lower operating and maintenance costs; foster introduction and commercialization of low- and zero-emission transit vehicles; complement efforts under the PNGV program for automobiles; and enhance the vitality, competitiveness,

and responsiveness of U.S. industry in the fuel cell, electric, and hybrid-electric propulsion market. Work includes:

- Completing the development of fuel cell propulsion systems for transit buses. Fuel cells promise highly efficient and environmentally acceptable propulsion, with twice the operating efficiency of a typical diesel engine, with negligible emissions, and none of the range limitations of battery-powered buses. Both the phosphoric acid fuel cell and the proton exchange membrane fuel cell technologies are being developed for bus propulsion systems. This will include demonstrating a fuel cell on the ATTB. Partnering with FTA in this multi-year program are the Defense Advanced Research Projects Agency (DARPA) and the Department of Energy.
- Continued research into safe handling of fuel for fuel cells and for technical support to augment the capabilities of the FTA staff to conduct engineering analysis and evaluation of emerging bus propulsion technologies. FTA will continue to collaborate with DARPA, the Department of Energy, the Environmental Protection Agency and the Department of Interior (National Park Service) for near-term applications.
- Accelerated demonstration of more efficient hybrid-electric and all electric transit vehicle technologies, which will become the next stage of improvement from diesel buses currently in operation.

### ***Related Departmental Activities***

#### *Servicewide Safety and Environmental Compliance (USCG)*

To facilitate compliance with safety and environmental laws, USCG conducts a range of research efforts in the areas of vessel safety, pollution prevention, aviation engineering support, and vessel loss exposure and risk analysis. Current activities with the potential applicability to other surface modes include: development and laboratory testing of a fuel cell propulsion module to determine engineering, safety, and economic characteristics; and development in conjunction with EPA of portable methods to measure ship air pollution; assessment of current USCG cutter emissions.

#### *Support for Interagency Ship Structure Committee (USCG)*

As discussed above, the Ship Structure Committee (SSC) coordinates interagency efforts by sponsoring research projects of mutual interest that apply advanced technology to the maintenance, repair, and economical construction of ships. USCG support of these efforts focuses on advanced composites, rupture resistant cargo ship designs, failure definition for assessing structural reliability, and in-service nondestructive methods for assessing fatigue and fracture properties of ship structures.

## CHAPTER 5

### HUMAN-CENTERED TRANSPORTATION SYSTEMS

Acting as operators, crew members, or passengers, people are essential components of all transportation systems. Their capabilities, decisions, and performance significantly affect the transportation system's overall safety and efficiency. Likewise, there is no doubt that reducing or mitigating human errors could improve safety: Approximately 60 to 80 percent of all transportation accidents involve some form of human error.

Today, transportation is undergoing a revolution. We are developing, introducing, and adopting many new technologies, largely based on advanced information and computer systems, to assist transportation operators in making critical decisions. If properly employed, these technologies can dramatically improve transportation safety, reliability, and productivity. However, these gains will in large part depend on properly incorporating the human as a central element in the new systems.

As they are applied to transportation, advanced technologies often do not achieve their full potential because of a failure to consider fully the human factors involved in technology use. If we are to realize significant improvements in safety and efficiency, it is imperative that we design, employ, and operate new technologies from a "human-centered" perspective. Human-centered approaches recognize that technology can be only as good as the humans that operate it. The success of human-centered technology comes from putting people first and recognizing that the human contribution is a critical part of technology development and implementation.

The NSTC Committee on Transportation R&D has identified three components of human-centered technology:

- *Human-centered interfaces — Focusing design, product, and systems development to fully anticipate, take advantage of, and effectively use human capabilities.*
- *Human-centered operations — Focusing on ways to make operation of systems more effective and safe through improvements in procedures, training, and selection.*
- *Human-centered systems integration — Focusing systems design, construction, and implementation to include fully the human user in the assessment of safety, security, environmental risk, comfort, efficiency, economics, and choice.*

By contributing to safety and productivity, R&D in the area of human-centered technology supports National goals for economic growth, competitiveness, and job creation. Because human performance R&D often lacks private support, and because human performance is crucial to the safety of the transportation system, Federal investment and leadership is

required. The objective of Federal efforts supporting the development of human-centered transportation systems is to ensure that needed data and methods are available to U.S. industries that design and produce advanced transportation technologies. The following surface transportation programs have human-centered concerns as their primary focus. Related near-term programs are discussed in the next section.

### ***Near-Term Efforts***

#### *Commercial Vehicle Operator Human Factors (FHWA)<sup>15</sup>*

The objective of this program area of the FHWA Office of Motor Carriers (OMC) is to ensure that commercial motor vehicle (CMV) drivers are physically qualified, have the knowledge and skills necessary to operate safely, are appropriately licensed, and are alert and unimpaired behind the wheel. The program embraces a broad range of topics, including CMV driver medical qualifications, loss-of-alertness/fatigue, substance abuse, and driver training.

Research results may form the technical foundations for changes to DOT's Federal Motor Carrier Safety Regulations, which primarily govern trucks and buses in interstate commerce. Accordingly, the topics for research are highly applied. The experimental designs provide representative models of real-world motor carrier operations. Near-term research activities include the following:

- Human Factors - New logistical realities such as just-in-time delivery and “zero” inventories, tagging and tracking, and communications, require the commercial driver to shoulder increased responsibilities for the efficient and timely movement of commodities. Consequently, human factors research has been, and will continue to be a top priority for OMC's research program.
- Technology - This includes research to develop and apply technology to monitoring driver activities in-vehicle, promoting the safe operation and maintenance of CMV components and systems, improving cargo securement, safe accommodation of multi-trailer combination vehicles, and safe transportation of hazardous materials.
- Information Analysis - The OMC *Analytic Strategic Plan* resulted in a number of recommendations to increase the role of analysis in planning. Models are being developed to measure the effectiveness of the OMC's major safety programs, and data collection for and testing of those models is currently underway.

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<sup>15</sup>Funding for this program is included in the Motor Carrier Research program, discussed in Chapter 4.

- Regulatory Reform - The zero-base review of the Federal Motor Carrier Safety Regulations (FMCSR) was designed to examine all facts of commercial motor vehicle safety as though no regulations existed, through a comprehensive multiyear effort. The objectives are to improve CV safety, eliminate unnecessary burdens, improve the enforceability of existing regulations, make the regulations more understandable, and provide for the adoption of performance-based guidelines.
- Service and Partnerships - This includes cooperative research activities that aid State and local improvements to vehicle safety, inspection, and maintenance. The “no-zone” initiative, an effort to publicize the need for safe vehicle operation around commercial motor vehicles, is a current priority.

FY 1998 milestones will include:

- Dissemination of information about the impact of fatigue on drivers engaged in loading and unloading of vehicles, driving in local/shorthaul operations, and using sleeper berths.
- Identification of diagnostics that can effectively warn commercial drivers of faulty systems (e.g., brakes), verify vehicle emissions, determine the compliance status of the motor carrier, and offer an assessment of the factors contributing to CMV accidents.
- Development of a multi-disciplinary crash investigation course.

*Highway Safety Research (NHTSA)*

FY	1997	1998	1999
Funding	5,123	5,123	NA
FTE	17.15	18.15	NA

NHTSA's Highway Safety Research Program is designed to change the knowledge, attitudes, and behavior of drivers, passengers, pedestrians, bicyclists, and others who share the road. Results of the program are directed at both roadway users and at organizations, such as law enforcement agencies, the judiciary, and the senior citizen and health care communities, which are in a position to influence roadway users. The program has eight major components, with the largest effort aimed at reducing the effect of driver alcohol and drug use — clearly the principal cause of driver performance failure and a high priority for NHTSA. Key initiatives and ongoing research in each of the components include:

- Alcohol and Drugs — Determine the feasibility of expanded breath testing programs, assess use of advanced communications technologies to detect suspended drivers, develop prototype countermeasure programs for high-risk target groups, and improve police DWI patrol procedures and methods for detecting alcohol- and drug-impaired drivers.

- Occupant Protection Use — Develop better data on the causes for low usage rates in youth, rural residents, and minority groups. Develop strategies to improve levels of seat belt law enforcement. Conduct a biennial National survey on occupant protection issues. Determine crash consequences of common forms of child safety seat misuse.
- Older Driver Research — Identify ranges of common impairments and determine methods for measuring and modeling performance of drivers with various levels of impairment. Develop guidelines for police, licensing agencies, physicians and allied health professionals, and friends and family members to assist older drivers in making appropriate decisions about driving.
- Pedestrian and Bicycle Safety — Develop cost-effective countermeasures for states and localities. Assess public attitudes and awareness of pedestrian and bicyclist safety problems. Evaluate pedestrian safety zone approaches in reducing crashes involving older pedestrians. Develop safety countermeasures for specific types of bicyclist/motor vehicle crashes. Examine the involvement of various populations in alcohol-related pedestrian crashes.
- Speed and Unsafe Driving — Complete 1) a crash investigation study to determine when, where, and under what conditions speeding leads to crashes; and 2) a nationwide driver survey on why drivers speed and engage in other unsafe driving behaviors, including the conditions under which such behaviors occur. Develop enforcement strategies.
- Driver Education — Adapt curriculum materials to fit two-phased instruction coordinated with states' provisional or graduated license systems. Develop support training modules, including the use of parents and other adults in improving driving practice and decision-making skills and the use of electronic simulators to improve the teaching of safe driving.
- Driver Fatigue and Inattention — Collect and analyze information regarding the role of fatigue and inattention in crashes. Develop and test technological, informational, and educational countermeasures to reduce the incidence of these factors.
- Evaluation — Document and assess implementation processes and evaluate existing and new countermeasure programs to determine their impact and suitability for widespread adoption. Evaluate occupant protection demonstration grants, alcohol-impaired driving countermeasures, the Safe Communities Program, and various other innovative state and local programs.
- Emergency Medical Services (EMS) — Render technical assistance and support for the development of organized systems of emergency medical care. Provide the technical foundation and support to facilitate further research among the broad EMS community.

- Social Marketing — Identifying sub-groups of the population that are most in need of intervention, devising approaches that will be effective with those sub-groups, and choosing delivery mechanisms that will effectively reach them.
- Injury Control — Identify traffic injury patterns, design interventions to address the identified causes, and field test the resulting programs to determine the extent to which they reduce the number of injuries.

A major milestone for FY 1998 is to determine the crash risk for various blood-alcohol levels.

*Human Factors Research (FRA)*

FY	1997	1998	1999
Funding	2,000 <sup>16</sup>	2,000 <sup>17</sup>	NA
FTE	2	2	NA

This FRA research program is designed to improve railroad industry safety and productivity through an improved understanding of human performance, and through the development, characterization, and demonstration of technologies and practices that fully support system operators. Current activities include the completion of the evaluation of test designs for dispatcher workload, stress, and fatigue; reporting on optimal acoustic warning system research; and reporting on dispatcher training practices. A major FY 1998 milestone will be the publication of advanced ergonomic design concepts for operator displays for new generation locomotive cabs and dispatcher control centers.

*Maritime Safety (MARAD)*

FY	1997	1998	1999
Funding	0	0	NA
FTE	NA	NA	NA

MARAD's program focuses on a human-centered approach to the practical application of behavioral science principles to implementation of people improvements in transportation maritime systems. Improvements are necessary because of the high probability of human error, the extreme competitiveness in international trade, the rapid introduction of automation advances combined with great pressures for low manning levels, and the significant safety and environmental impacts of maritime accidents. Research initiatives are accomplished largely

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<sup>16</sup>Included in funding for FRA *Equipment, Operations, and Hazmat* research (\$5,545k in FY 1997).

<sup>17</sup>Included in funding for FRA *Equipment, Operations, and Hazmat* research (\$5,509k in FY 1998).



through industry-government cooperatives involving industry leadership. Near term cooperative research initiatives include:

- Human Factors Cooperative Research Program with the Federal and the six State Maritime Academies. The program consists of shared research efforts to apply human factors knowledge and advanced technologies to improve safety and performance of maritime transportation. Projects benefiting the entire industry are identified and their execution shared by the cooperative members. Projects range from developing a bibliographic data base of maritime human factors resources for the World Wide Web to reforming the education of cadets to include human factors elements such as bridge resource management concepts to developing a consensus view of the maritime transportation system in the twenty first century.
- Vessel Piloting Cooperative Program with the American Pilots Association (APA) with its more than 50 member associations. The program works through the APA Navigation and Technology Committee and develops efforts that seek to apply advanced technologies to provide practical improvements to the safety of piloting operations in U.S. waterways. Focus is on human factors aspects and ship-pilot interactions and the use of advanced electronics and technology.

One FY 1998 milestone for the Vessel Piloting Cooperative is to complete test and evaluation of portable navigation technologies by pilot associations through the Piloting Cooperative and report results to the industry through workshops or symposia.

*Safety and Security (FTA)*

FY	1997	1998	1999
Funding	650	1,100	NA
FTE	NA	NA	NA

The performance of transit operators is a key determinant of the personal safety of transit passengers, and of the ability to deter security threats to transit passengers, vehicles, and facilities. The goals of FTA's Safety and Security work are to improve personal security and operational safety, to develop and demonstrate new and innovative security and safety technologies, and to improve emergency management planning. These goals are accomplished primarily through a program of technical assistance workshops, training, and regulatory support. Ongoing research projects include the following:

- Regulatory Support — Provide assistance to grantees and states in implementing Federal requirements for drug and alcohol testing of safety-sensitive employees and for state safety oversight of fixed rail systems through the dissemination of training materials and technical guidance.

- Industry Support — Provide training for approximately 6,000 students annually through the Transportation Safety Institute on subjects that include system safety, accident prevention and investigation, system security, emergency management, and alternative fuels handling. Collect, analyze, and publish safety and security data. Provide outreach to transit authorities through a National clearinghouse and bulletin board on safety and security matters.
- Security — Provide technical assistance to transit systems seeking to replace traditional security strategies with more proactive, creative approaches. Conduct security audits to support enhancement of transit security operations.

An important milestone for FY 1998 is to implement a process for auditing grantees' drug and alcohol testing programs.

### ***Related Departmental Activities***

#### *Aviation Human Factors (FAA)*

FAA human factors programs are responsive to the *National Plan for Civil Aviation Human Factors*. This plan, jointly developed by the aviation industry, academia, NASA, DOD, and the FAA, establishes a behavioral research agenda and strategies to enhance the safety and efficiency of the aviation system. The FAA core research program includes:

- Human-Centered Automation — Establishment of human interface design principles and criteria for automated and advanced systems.
- Selection and Training — Establishment of criteria and techniques for efficiently acquiring and training aviation personnel.
- Human Performance Assessment — Establishment and utilization of measures to assess individual, crew, and organizational human performance in aviation systems.
- Information Management and Display — Establishment of critical human performance parameters required to effectively transfer information in the aviation system.
- Bioaeronautics — The bioengineering, biomedicine, and biochemistry associated with performance and safety.

#### *Marine Safety (USCG)*

This Coast Guard program addresses a variety of issues concerning professional and nonprofessional operators with a wide range of skills, from highly trained ship masters to

barge operators, fishing boat crew, and recreational boaters. Human factors data on operation of oceangoing vessels is shared with the Maritime Administration. Near-term research priorities include:

- Developing methods to improve crew alertness on towing vessels.
- Developing risk-based resource allocation methods.
- Improving the understanding of the causes of human error through data collection and incident analysis.

## CHAPTER 6

### INTERMODAL SYSTEMS ASSESSMENT, DESIGN, PLANNING, MANAGEMENT, AND OPERATIONS

System assessment capabilities need to be applied across the wide range of activities and externalities associated with the entire transportation enterprise; covering both the system as a whole as well as its individual elements. This need is evident in the research, investment, operational and policy decisions made by both public agencies and the private sector. In many cases, the results of a single system assessment activity -- whether it be data and information or analytical judgments -- can support a wide range of transportation decisions. In general, however, it is possible to sort the application of transportation system assessment capabilities in the Federal government into two broad categories: support for infrastructure planning, design, management and operations; and support for public policy decision making.

#### *Infrastructure Planning, Design, Management and Operations*

Perhaps the most clear-cut role for system assessment lies in the planning and design of transportation infrastructure construction and rehabilitation activities, and in managing existing facilities. Without credible quantitative measures of current performance, the degree of need for improvements in one area cannot be judged or compared to other uses of the same resources. The multi-dimensional costs and benefits -- covering economic, safety, environmental, energy, and mobility and access issues -- of alternative courses of actions, including the decision to "do nothing", can only be known if the data, analytical tools, performance measures, and other elements of system assessment are available.

Similar issues arise in evaluating choices among operational strategies and practices. For example, better understanding of flows on networks, and the underlying transportation needs that shape them, can facilitate improved system management and operations and better maintenance, fleet assignment, and vehicle replacement decisions. This is equally true for a public sector transit agency or for a private sector airline or trucking company. Broad system assessment knowledge is even more important in responding to complex topics such as tradeoffs between demand management and increased capacity.

At present, widespread gaps exist in our capabilities in this area. Many of the models and data available to address these issues often provide an inadequate foundation for satisfactory resolution. And the current movement toward shifting many transportation infrastructure responsibilities to Metropolitan Planning Organizations (MPOs) and other state and local authorities creates the challenge of assuring that these organizations, which often possess limited resources, have the tools and information necessary to make cost-effective long-term decisions. Thus, there is a need for better infrastructure investment-related models that can be applied by authorities without high level skills and that can cover such topics as life-cycle

costs; the incremental costs associated with attaining accessibility, environmental and other social goals; and intermodal system optimization.

### *Public Policy Decision Making*

Policy and other decision making, including decisions about transportation research and development, require effective data collection and analysis. The absolute and relative values of research in infrastructure materials, vehicle technologies, intelligent transportation systems, and other topics can be judged only on the basis of substantive estimates and comparisons of their impacts on the cost, quality and availability of transportation services and equipment. What would the impacts be of potential innovative transportation technologies, such as a passenger car with 3 times current fuel efficiency? In the transport of hazardous materials, where are the most serious risks for harm and what improvements will have the greatest payoffs? How can new technologies be deployed to benefit transportation? Making the best and most cost-effective transportation investment decisions requires a solid and robust capability for assessment of existing and innovative transportation technologies and their potential impacts. Many DOT programs have associated assessment efforts and BTS serves DOT needs as a policy-neutral focal point for National transportation data.

While outside input is essential, the Federal government can and must take the lead. It is in the best position to coordinate efforts by the transportation community to assess the opportunities and challenges of the future. It can play a key role in developing the necessary knowledge and tools, given the long time-frame associated with transportation investments, the potentially broad impacts of regulatory and policy decisions, and the need for a broad perspective in monitoring social, economic, demographic, and technological trends.

As is discussed in Chapter 6 of Section II, among the most important elements of system assessment are performance measures, data, analytical tools, technology assessments, and awareness of anticipated trends. These are discussed in greater detail in that portion of the report. The Department's plans for R&D in these areas over the next 3 years is presented below.

### ***Near Term Efforts***

#### *Policy Research (FHWA)*

FY	1997	1998	1999
Funding	5,328	8,000	NA
FTE	6.0	8.0	NA

The objectives of FHWA's policy research program are to provide efficient and timely data collection, management, and dissemination concerning highway transportation; to perform

quantitative analysis of key economic, energy, and financing issues that must be addressed in developing highway policy; and to develop systems and tools to analyze highway system condition, performance, and efficiency.

Policy research is essential for the development of Federal highway policies that are responsive to Federal interests in promoting interstate commerce and improving the competitiveness of domestic products in international markets. Policy research addresses many of the short- and long-term Federal highway policy issues raised in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and will provide analytical tools and data needed to analyze highway program alternatives for the 21st century. Current research efforts include:

- Data Management and Dissemination - To support the needs and expectations of the transportation program, including the NHS, FHWA partners with State and local data collection agencies to address fuels and finances, system performance, traffic monitoring, surveys and censuses, and data dissemination.
- Analysis of Economic, Energy, and Financing Issues - In order to address the unprecedented interest in economic, environmental, energy, and financing issues affecting the highway program, FHWA policy research supports analyses of long-term relationships between highway and intermodal accessibility and the productivity of firms in various industries; development of an improved understanding of the importance of highway transportation to production processes in various industries; and improving analysis methods to explicitly consider external costs and benefits associated with highway investments.
- Productivity and Efficiency of Highway Investments - In order to appropriately weigh investment alternatives, it is important to understand both direct and “external” benefits and costs. The Highway Economic Requirements System (HERS), which supports the biennial report to Congress on the conditions and performance of the Nation’s surface transportation system, requires updating to provide greater accuracy under a wider range of conditions and circumstances. Truck size and weight (TS&W) and highway cost allocation research is also included in this area.

Major milestones for fiscal year 1998 will include:

- A test of remote sensing for traffic monitoring will be conducted. Aerial imaging and ground counts will be integrated into an estimate of total area wide travel.
- Guidance to States and MPOs based on evaluation of early innovative financing efforts. This research will summarize and evaluate experiences in implementing innovative financing strategies in different situations as well as examine implementation of new strategies that are being tested.

- Evaluation of the implications of technological and other innovations affecting passenger and freight transportation on future investment requirements. One specific element of this analysis will be to more explicitly include intelligent transportation infrastructure investment in estimating future investment requirements.

*Highway Planning Research (FHWA)*

FY	1997	1998	1999
Funding	5,889	16,025	NA
FTE	4.0	6.0	NA

FHWA's highway planning research program is designed to develop cost effective methods for State, regional and local governments to evaluate transportation investments and alternatives. Its further goals are to develop and disseminate improved metropolitan and statewide transportation planning methods to enhance the understanding and analysis of land use, intermodal transportation, congestion and environmental interrelationships and to implement planning processes that meet legislative requirements.

Current research priorities include:

- Travel Demand Models - This includes the development and dissemination of improved methods for major investment studies and methods to assess alternative multimodal investment proposals, including social and environmental costs. The *Travel Model Improvement Program* (TMIP), which is conducted jointly with OST, FTA, EPA, and DOE, is a major emphasis in this area. This effort includes the Transportation Analysis and Simulation System (TRANSIMS) program, a major initiative to develop a new generation of transportation models using a microsimulation approach. This is a multiyear project performed by the Los Alamos National Laboratory.
- Congestion Management and Mobility Enhancement - The objective of this research is to develop tools to support MPOs, State DOTs, and local governments in their transportation analysis and investment decisions.
- Finance and Economic Analysis - Increased emphasis is being placed on utilizing innovative ways of financing federal-aid highway projects. Financial analysis tools are needed in order that these innovative financing mechanisms may be considered within the financial segment of the transportation planning process.
- Training, Education, and Technical Assistance - A comprehensive planning research program is being established to close the gap between state-of-the-art and state-of-the-practice in the next five to ten years. Background information and intermodal planning

procedures will be integrated with advanced technologies such as GPS, GIS, and multimedia presentations to promote better multimodal planning.

- ITS Deployment Assessment System - A sketch planning tool is being developed to assist planners in considering ITS alternatives in the course of their analysis of future needs. IDAS is being developed specifically to complement TRANSIMS.
- Alternative Data Collection, Analysis, and Use - Downsizing of government data collection programs, and the formalized requirements for statewide intermodal planning necessitate a major activity to provide data necessary for intermodal planning at all levels of government. This activity will focus on innovative collection methods, effective analysis and presentation techniques, and refinement of intermodal information systems.
- Sustainable Transportation: Land Use and Redevelopment Planning Tools, Cases, and Pilots - This new initiative will address an array of issues, as broad as metropolitan areas contribution to global climate change, and as specific as the benefits of restoring and redeveloping contaminated areas for infill development. Over a multi-year period, FHWA will develop analytical tools to support MPOs, State DOTs, and local governments in their transportation analysis and economic development decisions from the standpoint of their land use and environmental impacts. FHWA will help fund pilot projects to demonstrate the effectiveness of these tools and to determine alternative strategies for fostering sustainable transportation and development, including reinvestment in abandoned or underutilized industrial and commercial areas in the urban core.

Major milestones in FY 1998 will include:

- Identification of freight, vehicle, and person forecasting procedures in use by the States.
- Case studies of State DOT and MPO application of methods for identifying and relieving congestion.
- A report addressing how States and MPOs integrate multimodal transportation investments and economic development analysis in transportation planning processes.
- Technology transfer on forecasting procedures for vehicles, persons, and freight.
- Demonstration of the application of advanced technology for intermodal data collection.
- Identification and assessment of effective methods of collaboration of planning efforts traditionally conducted at different jurisdictional levels (e.g., State, metropolitan, county, city, or town).



*National Advanced Driving Simulator  
(NHTSA/FHWA)*

FY	1997	1998	1999
Funding	14,000 <sup>18</sup>	12,250 <sup>19</sup>	NA
FTE	NA	NA	NA

In February 1996, the National Highway Traffic Safety Administration (NHTSA) announced the award of a \$34.1 million contract to TRW's Transportation System Division in Sunnyvale, Calif., for the development, testing and installation of the National Advanced Driving Simulator (NADS). This simulator will offer a major advance in helping researchers to understand the human factors involved in traffic crashes, in order that their frequency can be reduced.

The NADS will be the world's most technically sophisticated research driving simulator, capable of providing test drivers with an experience that nearly duplicates real world driving. The facility will be located at the University of Iowa in Iowa City at the Oakdale Research Park. The University of Iowa was selected for the NADS site based on the recommendations of the National Science Foundation, which helped NHTSA to conduct a National competition among major transportation research universities for the potential site for the NADS. The construction of the simulator will be completed in 39 months and it will become operational in spring 1999, under the NHTSA's stewardship.

The University of Iowa has agreed to provide cost sharing to the NADS project in the amount of \$11.58 million. This will include the design and construction of a \$5.7 million building, which will be a facility dedicated to housing the simulator operation.

The NADS will primarily be used to conduct fundamental research in traffic safety, integrated vehicle safety systems, and advanced vehicle design. The NADS could also be used for human factors research, since it will be able to put drivers in realistic problem situations such as the sudden appearance of a child in the road, a skid on glare ice or an oncoming vehicle driving over the centerline. Imminent crashes can be simulated without the unwanted and unsafe consequences of crashes on the highway. The study of driver reactions can lead to potential improvements in vehicles, highway and vehicle design, and advanced safety systems.

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<sup>18</sup>Funding through FHWA/ITS from ISTEA Section 6058.

<sup>19</sup>Funding through FHWA.

Current NADS priorities are to:

- Complete the detailed design and design review of all subsystems.
- Initiate fabrication, installation, and test of the facility.

An important milestone for FY 1998 will be to complete facility building construction.

*Fatal Analysis Reporting System (NHTSA)*

FY	1997	1998	1999
Funding	5,242	5,242	NA
FTE	6.40	6.41	NA

The FARS annually compiles detailed information regarding the drivers, occupants, vehicles and environmental conditions associated with all fatal motor vehicle crashes occurring in all 50 states, the District of Columbia, and Puerto Rico. Maintenance of this data base is based on 52 cooperative agreements between DOT and the governments of these jurisdictions, which cover the collection and coding of data on fatal motor vehicle incidents. Among the data categories included in FARS are: demographic data and alcohol levels of fatalities, use of safety belts and child restraint devices, types of vehicles and their crash-related movement ("first harmful event"), types of road and roadway surface conditions, time of day, light and atmospheric conditions, and emergency medical services response times.

FARS is a key database for the study of fatal crashes and their causes, as well as the development and implementation of possible measures to ameliorate the number of such incidents and their severity. Users include researchers, analysts and policy makers from Federal, state and local government, universities and other research organizations, private interest groups and the transportation industry. A key fiscal year 1998 milestone will be the completion of the first year of a second five-year cooperative agreement with the 50 states, Washington D.C., and Puerto Rico.

*National Automotive Sampling System (NHTSA)*

FY	1997	1998	1999
Funding	9,658	9,658	NA
FTE	10.67	10.68	NA

The NASS is an extensive, nationwide data collection system managed by NHTSA's National Center for Statistics and Analysis, which compiles information on both fatal and nonfatal motor vehicle crashes. The NASS has two components: the General Estimating System (GES) and the Crashworthiness Data System (CDS). In the GES, data collectors regularly

visit several hundred law enforcement agencies and select a random sample of approximately 52,000 Police Accident Reports (PARs) from among the more than 6 million such reports filed annually in the United States. The CDS contains crashworthiness-related data from detailed investigations of approximately 5,500 passenger vehicle crashes annually.

Information from these samples is entered into the NASS databases and is made available to Government agencies, researchers, transportation businesses, insurance companies, and the general public. These NASS resources are used extensively to identify and analyze trends in motor vehicle crashes, to discern highway safety problem areas, to support highway safety rulemaking and research (such as ITS), and to form the basis for cost and benefit analyses of potential highway safety initiatives. A major milestone for fiscal year 1998 will be the collection and coding of NASS data in 26 states.

*Data Analysis Program (NHTSA)*

FY	1997	1998	1999
Funding	1,635	1,935	NA
FTE	13.88	12.82	NA

The NHTSA Data Analysis Program supports the agency's achievement of its Government Performance and Results Act of 1993 (GPRA) performance goals by providing sampling, statistical design, and quality control support to NHTSA's major data collection systems, including the FARS, CDS, and GES. These services are provided to both internal (NHTSA) and external (other Federal agencies, nongovernmental) customers of these important highway safety data systems. This program also produces regular statistical reports on highway safety and motor vehicle crashes.

Among the uses of the data made available through this program are evaluations of the effectiveness of NHTSA's crashworthiness, crash avoidance, and traffic safety efforts, as well as relating human, vehicle, roadway, and environmental factors to the frequency of crashes and injuries. A key milestone for fiscal year 1998 will be the identification of injury mechanisms and associated outcomes in motor vehicle crashes.

*State Data Program (NHTSA)*

FY	1997	1998	1999
Funding	3,041	3,041	NA
FTE	9.61	9.61	NA

In addition to NHTSA, individual states also manage highway safety databases, compile statistics, and prepare reports on highway safety and crashes. NHTSA's State Data Program is the major interface between the agency and these state level data systems. The Program

obtains highway safety data files for NHTSA from 17 different states, assists states in making improvements to state data collection efforts and data systems, and promotes the development of linked databases that combine information from motor vehicle crashes and the medical outcome of treatment for crash victims. This latter function is particularly important to meeting NHTSA's health care initiatives.

Among the program's near-term goals are promoting the increased use of linked crash and medical outcome databases by states. The results of this effort can be then used by the states to develop and evaluate initiatives to prevent injuries from traffic crashes and enhance health care for crash victims. Major milestones for the 1998 fiscal year will be obtaining, documenting, and making available for use the data files from 17 states and awarding cooperative agreements to up to two additional states to link and use their crash and medical outcome databases.

*Occupant Protection Survey (NHTSA)*

FY	1997	1998	1999
Funding	300	300	NA
FTE	1.00	1.00	NA

The goal of the Occupant Protection Survey program is to support NHTSA's efforts to promote the increased use of safety belts, child safety restraints, and motorcycle helmets by the general public. This was accomplished by a second National Occupant Restraint Use Survey, which was conducted in FY 1997. Periodic surveys of safety belt and child safety seat use and misuse are critical needs of our safety belt use program. A major milestone for fiscal year 1998 will be the analysis and publication of results comparing the FY 1994/1995 and the FY 1996/1997 National Occupant Protection Use Surveys.

*Special Crash Investigations (NHTSA)*

FY	1997	1998	1999
Funding	331	1,031	NA
FTE	1.07	1.07	NA

NHTSA's major data activities -- such as FARS, NASS, and the Data Analysis Program -- cover the vast majority of highway safety and vehicle crash circumstances. However, there are specific safety-related topics which require a more focused and detailed approach. The Special Crash Investigations program tackles these problems. It is the agency's primary resource for studying the safety issues associated with new technologies, such as air bags and alternative fuels, as well as potential motor vehicle safety defects. In pursuit of this goal, the program conducts approximately 50 detailed crash investigations annually covering such diverse issues as school bus crashworthiness and fatalities, potential vehicle safety defects, the

performance of automatic restraint systems, and electric vehicles. A major milestone in fiscal year 1998 will be the creation of an electronic file of all special crash investigations.

*Technology Transfer Programs (NHTSA)*

FY	1997	1998	1999
Funding	40	40	NA
FTE	1	1	NA

The goal for this program is to provide more timely information about NHTSA's safety research and development results, contracts, and reports to the interested motor vehicle and traffic safety community by periodically publishing and distributing a technical journal, *Auto & Traffic Safety*. It contributes to the larger goal of a healthy, educated citizenry. The major fiscal year 1998 milestone will be the production of two additional issues of this journal.

*National Security (MARAD)*

FY	1997	1998	1999
Funding	0	0	NA
FTE	NA	NA	NA

The fifth goal of the MARAD Strategic Plan is to "provide sealift for National security and the National defense." The American maritime industry is a vital component of our Nation's defense, both in providing strategic sealift and in supporting the shipbuilding and repair industrial base. MARAD is a partner with the industry and the Department of Defense (especially the U.S. Transportation Command) in ensuring that this goal is met. New R&D initiatives in this area for fiscal year 1998 include:

- Initiation of projects to assist in the administration of the Maritime Security Program (MSP) and related functions to ensure the availability of a modern, efficient merchant marine to support National security objectives.
- Initiation of analysis of various sealift planning strategies under different mobilization scenarios taking into account factors such as manning requirements and availability, increased use of containerization and other commercially adaptable cargo handling practices by the military, geographic effects on trade, multiple theatre conflicts, and varying lift requirement levels.

*Transit Services and Management Innovation (FTA)*

FY	1997	1998	1999
Funding	1,500	700	NA
FTE	NA	NA	NA

The goals of the Transit Services and Management Innovation Program are to enhance transit services to improve the quality of life for all Americans through research, demonstrations, technical assistance, and evaluation of innovative transportation methods and services that enhance mobility, access, transit operations and management, and intermodal services. This includes deployment of innovations in fare policies, structures and fare collection methods and techniques such as bus route evaluation standards, customer satisfaction index, passenger transfer policies and application of GIS databases. The request also involves project case studies, formal project evaluations, and technical information dissemination to facilitate technology transfer and encourage widespread adoption of successfully demonstrated service and management innovations, including updating current technical information for the FTA Internet Home Page, publishing and distributing technical reports and abstracts, and conducting workshops and seminars.

*Rural and Specialized Transportation (FTA)*

FY	1997	1998	1999
Funding	2,500	2,500	NA
FTE	NA	NA	NA

Through the Rural and Specialized Transportation Program, FTA will bring together the Administration's various rural and specialized research and technical assistance efforts in order to provide adequate assistance to develop innovative and creative solutions to many problems that impact the rural and specialized transportation industry. Major current activities include the following:

- Service experimentation, technical assistance, and governmental resource coordination, as well as advanced technologies in customer information, dispatching systems, and automatic fare collection. Special emphasis will be placed on service innovations for citizens impacted by welfare reform and residents of rural areas.
- Formulating vehicle maintenance research for specialized accessible equipment as it impacts the Americans with Disabilities Act.
- Developing research and technical assistance for the development of universal securement systems for rural and specialized transit systems.

Major FY 1998 milestones will include:

- Technical assistance to enhance mobility for the disabled, and low income transportation passengers in rural areas.
- Innovative transportation strategies for services provided by the Departments of Health and Human Services, Education, Agriculture, and Labor.
- Team Transit demonstration project in Minneapolis, technical support for the autonomous dial-a-ride transit system under development in Corpus Christi, Texas and the Independent Transportation Network (ITN) demonstration for elderly transit customers in Maine.

*Metropolitan/Rural Policy Development (FTA)*

FY	1997	1998	1999
Funding	300	1,000	NA
FTE	NA	NA	NA

The goals of FTA's Metropolitan/Rural Policy Development research are to develop better estimates of transit's condition, performance and long-term investment needs; identify and evaluate the benefits of transit; conduct research into the relationships between transit and land use planning; provide technical assistance to encourage the use of and develop new innovative financing techniques; support the State Infrastructure Bank pilot program; and conduct outreach on transit's contribution to the future of cities and neighborhoods. This includes the refinement of national data on transit's role and performance in serving needs of passengers and communities, including transit's role in providing basic mobility, relieving traffic congestion, and contributing to community vitality.

*Transportation Planning and Project Development Research (FTA)*

FY	1997	1998	1999
Funding	700	1,200	NA
FTE	NA	NA	NA

FTA funds research in support of the metropolitan and statewide transportation planning and project development process. Activities carried out under the Planning and Project Development program ultimately assist state and local transportation planners in implementing the multimodal planning requirements contained in ISTEA. The major objective of these activities is to develop a better understanding of social, environmental, and economic phenomena related to transportation investments in order to develop and encourage the use of better evaluative tools and processes for transportation planning and priority setting.

*Human Resources (FTA)*

FY	1997	1998	1999
Funding	150	500	NA
FTE	NA	NA	NA

FTA's activities related to Human Resources are intended to encourage increased minority and female employment in the transit industry and methods and techniques to train and maintain qualified transit operations personnel, including: providing training for grantees to enable them to successfully implement their diversity programs; providing courses in minority high schools and colleges/universities to prepare students for careers in transit; and developing methods and techniques to train unemployed persons and underemployed employees for entry-level employment and higher-level employment. These resources will bolster efforts to promote careers in transit to assure a pipeline of qualified educated persons entering the transit industry. The request will also provide support for meeting Federal requirements, including: conducting an outreach program for disadvantaged businesses to advise them of special initiatives that offer significant contracting opportunities; conducting training for ADA compliance reviews and complaint investigations to ensure full compliance; and incorporating environmental justice requirements, which safeguard minority communities against adverse environmental and safety impacts, into on-going civil rights compliance reviews.

*National Transit Institute (FTA)*

FY	1997	1998	1999
Funding	3,000	3,000	NA
FTE	NA	NA	NA

The NTI, located at and managed by Rutgers University, assists the transit industry in the training and development of its workforce by developing and conducting training in support of the transit industry, mostly in the field. The NTI plays a key role in FTA's efforts to build professional capacity in the transit industry, particularly as it relates to the introduction and deployment of new technology and related support systems. FTA, the NTI and the transit industry have formed a partnership around the need to train and develop transit professionals at a time when resources are shrinking and demands for greater efficiencies in performance and productivity are rising.

Curriculum has been developed to train transit operators in how to implement and meet Federal regulations, standards and policy initiatives, such as the ADA and Clean Air Act Amendments. In addition, courses are available that provide hands-on experience in new technological methods and techniques. Subjects such as geographic information systems (GIS) and automatic vehicle monitoring are just a small sample of offerings underway. NTI will continue to promote best practices in training and make available subject matter experts at conferences and workshops.



*Rural Transit Assistance Program (FTA)*

FY	1997	1998	1999
Funding	4,500	4,964	NA
FTE	NA	NA	NA

The Rural Transit Assistance Program (RTAP) provides training and technical assistance for rural public transportation operators, improves professionalism and safety of rural transit services, and supports coordination with human service transportation providers. Major activities include training for drivers, mechanics, and rural public transportation managers; support for implementation of drug and alcohol testing requirements; and technical assistance needed by rural transit and human service transportation providers. Major fiscal year 1998 milestones will include

- Provision of training and technical assistance to rural transit operators in each state.
- Increased use of information and communications technology to support transfer of best practices.

*Research and Technology (RSPA)*

FY	1997	1998	1999
Funding	6,580	5,296	NA
FTE	NA	NA	NA

The goal of RSPA's Research and Technology (R&T) program is to provide departmental leadership for national transportation research by advancing U.S. transportation technology and the U.S. transportation enterprise; by providing the Department with the technical and analytical base to ensure that R&D planning decisions are technically and strategically sound; and to apply technological advances to improve U.S. transportation system mobility, safety, security, and efficiency.

Current RSPA R&T activities include:

- Completing a Government-wide *Transportation Science and Technology* document.
- Holding 3-5 national roundtables on R&D strategies and performance measures.
- Conducting strategic planning for transportation research, culminating in the annual development of the Department's *Surface Transportation Research and Development Plan*.

- Conducting analysis and developing working papers supporting the Department's participation in the interagency National Science and Technology Council (NSTC) and DOT's internal R&T Coordinating Council and Steering Committee.
- Conducting a program-level evaluation of the effectiveness of the University Research Institutes (URI) program.
- Investigation of the potential for robotics for maintaining transportation structures, and of the potential for application of biomechanical and nanotechnology systems in transportation.

Key FY 1998 milestones will include:

- Second editions of departmental Transportation Technology and Intermodal/Multimodal strategic research plans.
- An operational departmentwide R&D project tracking system.
- An expanded National Agenda for Human Factors Related Transportation Safety Research.

### ***Related Departmental Activities***

#### *Transportation Policy and Planning Research (OST)*

The OST Policy office conducts research activities and studies concerned with planning, analysis, and information development needed to support the Secretary's responsibilities in the formulation of national transportation policies. These responsibilities include: developing and coordinating environmental, energy, and safety policy; developing and implementing transportation economic policy; formulating and providing overall transportation radionavigation and positioning policy; and developing and coordinating aviation and international policy. Specific near-term research efforts in these areas include:

- Developing recommendations for improving transportation in a maturing society.
- Determining the feasibility and cost of applying the ADA to the marine passenger vessel fleet and related shoreside facilities.

- Providing overall management for the Travel Model Improvement Program (TMIP) and coordinating the various projects funded by the sponsoring agencies (FHWA, FTA, EPA, DOE, and OST).
- Synthesizing the best analyses performed to date on U.S. economic and trade trends and assessing their implications for future freight transportation requirements and federal programs and research priorities.
- Preparing the next edition of the *Federal Radionavigation Plan* (FRP).
- Strategic planning for long-term satellite navigation technology.
- Providing technical support to the Positioning/Navigation Executive Committee and Working Group.
- Interaction with civil users of GPS and other federally-provided radionavigation systems.
- Continuing analysis of the effects in the U.S. and Mexico of the removal of legal barriers to truck and bus operations in each country.

#### *Bureau of Transportation Statistics (BTS)*

BTS was created by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), partly in response to the perception that the data available to support transportation policy making and decisions were not sufficient for that purpose. BTS fulfills several important functions:

- Compiling, analyzing, and publishing a comprehensive series of transportation-related statistics.
- Coordinating data collection across the Federal government and identifying both short-term and long-term data collection needs.
- Issuing guidelines for the accurate and reliable collection of the information.
- Making the data readily accessible.

The mission of BTS is the establishment and maintenance of a comprehensive information infrastructure for transportation statistics and analysis from the perspective of users and markets, rather than specific transportation modes. Key customers are national, state, and local governments; transportation-related associations and the broader transportation community; private business and industry; and consumers. The goal of BTS is to provide transportation-related information to decision makers to enable them to make good decisions in

a timely manner, and with the right data. These decisions focus most importantly on transportation infrastructure investment, policies and planning, as well as on economic policy, safety, national defense, and national welfare.

BTS is committed to providing quality customer service and actively reaching out to and supporting the Department, the transportation community, and the public. BTS is responding to this challenge with the following efforts:

- First, the Bureau produces and distributes several data compilations, including the National Transportation Statistics and the 1990 Census Transportation Planning Package (CTPP) data tabulations in statewide and urban packages.
- Second, the Bureau is actively engaged in three major multimodal surveys on domestic freight movements, passenger movements, and transborder freight flows.
- Third, the Bureau prepares a number of analytical studies to address and help facilitate the national dialog about important issues such as the contribution of transportation infrastructure to economic growth, international competitiveness, and environmental quality. The centerpiece is BTS's Transportation Statistics Annual Report, which summarizes the state of the U.S. transportation system, the quality of the available statistics, and planned efforts to improve these statistics.
- Fourth, the Bureau has established a Geographic Information System (GIS) Center to provide data integration, display service, and analysis.
- Fifth, the Bureau provides public access to data and reports through a wide spectrum of channels and is developing new technologies to provide electronic library and archival services. Services include Internet, a toll-free statistical information hotline, and fax-on-demand.

Near-term BTS goals include the following:

- Integrating data on transportation from a variety of surveys (including Commodity Flow, American Travel, Rail Waybill, Waterborne Commerce, Air Passenger, and Domestic Transportation of Foreign Trade Surveys).
- Developing national performance measures and supporting interpretive material to answer the basic questions: is the system getting better or worse and what do we mean by better or worse. Particular emphasis will be placed on measures that capture the shipper and traveler perspectives.
- Improving tools for unburdensome data collection, data analysis, and information dissemination.

- Developing, with the Bureau of Economic Analysis, a Transportation Satellite Account.

A major milestone in fiscal year 1998 will be publication of results from the first American Travel Survey and data collection for the second Commodity Flow Survey.

### *BTS Interaction with Other Groups*

BTS participates in many Departmental and Federal activities. As discussed above, BTS provides information, analytical tools, and other services central to the National Transportation System initiative. BTS is a major partner with other DOT Operating Administrations in the development of new monitoring and forecasting methods for several key aspects of the Travel Model Improvement Program (TMIP). For the Administration's PNGV initiative, BTS is leading DOT's efforts examining infrastructure issues. As DOT's lead agency on the Federal Geographic Data Committee, BTS sponsors projects that directly support the National Spatial Data Infrastructure.

### *Long-Term Outlook*

An effective system assessment capability is essential to assuring that the goals of sustainability, economic vitality and personal mobility and access are fully incorporated into the transportation decision and policy making processes. Expanding research and development efforts in system assessment can help in attaining these goals. For example:

Recent technological advances in fields such as electronics, communications and information systems have magnified the potential benefits of data and information to the transportation community. Electronic Data Interchange (EDI) offers the possibility of real time data collection; computing power and new applications such as spreadsheets and Geographic Information Systems (GIS) enhance the ability to convert that data into valuable information; and the rapidly expanding information infrastructure will completely redefine the nature of making that information accessible.

Further support for the development of programs based on advanced computer and modeling and simulation techniques will enhance BTS's ability to address national transportation-related technical and policy issues.

Effective cost-benefit analyses require as complete and accurate a collection of actual costs and benefits as can be assembled. Currently, data on many of these are either missing or only partially available, especially in such areas as economic benefits and the environmental and human health costs of various transportation activities. Cost-benefit analyses are increasingly important as we face ever decreasing options for expanding capacity through infrastructure investment and transportation demand management strategies.

Research is just beginning on the behavioral responses of transportation users and providers to various transportation policy initiatives. This research is vital because future gains in throughput will likely rely more on economic incentives and other management strategies and less on adding physically to the transportation network.

Our current transportation system is the product of many elements -- including transportation-related institutions, organizations, incentives, policies, and others -- that are continually interacting with each other. There is a need to increase our understanding of this “non-material infrastructure” so stakeholders can interact with each other more effectively in planning and operations.

## CHAPTER 7

### DOT INVESTMENT IN UNIVERSITY RESEARCH, EDUCATION, AND COOPERATIVE INITIATIVES

Transportation efficiency and National productivity are inextricably linked. The capacity of the transportation system to enable the Nation to respond to international economic challenges is an increasingly critical factor in transportation research, development, and education. America's future prosperity depends on new ideas and the people who will develop and apply those ideas to ensure the safe and efficient movement of people and goods. In its role as steward of the transportation enterprise, the DOT invests in the ideas and the education of the people who will contribute to the transportation system of the future.

The transportation enterprise is undergoing great change. Technological advance, new trends and approaches to logistics, and institutional change are transforming how the public and private sectors operate.

#### *Technological Advance*

The development of new applications and the conversion of defense-related technologies to transportation uses will demand new knowledge, approaches, and education. The application of new information technologies, that are the basis of intelligent transportation systems, promise improved safety and mobility. The successful deployment of ITS requires that transportation research now include investigations of how modern communications, computer and sensor technologies may be integrated into surface transportation.

Innovations in other technologies promise to improve the transportation system. New materials could greatly increase the durability and longevity of infrastructure. Next generation propulsion systems and alternative fuels could revolutionize all modes of transportation. New analytical methods and modeling techniques may improve our understanding and operation of the transportation system. However, if successfully deployed, these technologies and methods will require an educated work force to understand how such technological advances can be successfully integrated into the transportation system and a trained work force to operate and maintain these new systems.

#### *Trends in Transportation Operations and Logistics*

Transportation companies and shippers' logistics departments have had to accommodate profound changes in their operating environment. These changes include increased international competition, the technology-driven move to integrated logistics processes, intermodalism, and the increasingly global outlook of major customers. The demand for the efficient, timely, and global movement of goods now dictates the application of technologies

that optimize the use of information and the entire transportation system as one. This approach to goods movement requires that transportation professionals be trained in the use of new information technologies and in the array of technologies available to respond to customer demands on a global scale.

### *Institutional Change*

In addition to advances in technology and business logistics, the transportation enterprise is undergoing institutional change. Transportation policy makers, planners, and operating departments at all levels of government are now increasingly sensitive to the implications of transportation on the natural environment and communities. Resolving transportation issues is no longer only the application of technology or the construction of a new facility--today's transportation professionals must understand the broader context of where transportation fits in a societal, economic, political and institutional framework in order to develop, plan, deploy, and operate effective transportation systems.

### *Strategic Co-Investment in Universities and Research Institutions*

Since World War II, universities and collaborative research partnerships have been the intellectual centerpiece of Federal policy for research, education, and innovation in all policy areas. Federal research and development grants and contracts have been integral to new discoveries, education of new researchers and the training of operators so to provide a steady stream of ideas to improve the Nation's security, health, and industry. DOT invests strategically in and partners with state and local governments, transit properties, universities, and research and training institutions to ensure that the transportation system maintains an adequate knowledge base and a pool of transportation professionals to operate a safe, competitive, and sustainable transportation system.

DOT relies particularly on universities because of their unique resources, capacity and qualifications in the area of knowledge-building, education and technology transfer, and their ability to bridge all sectors of the transportation enterprise.

The vast majority of scientists and researchers are located in institutions of higher learning. The largest proportion of government, corporate, and other institutional investment in research, development, and education is in universities. Compared to other cabinet departments DOT invests far less in university-based research. However, DOT's policy is to *leverage* its comparatively small investment by strategically co-investing with others, enabling it to take full advantage of all the talent, resources, and knowledge being developed in universities. The benefits to the transportation enterprise from this leveraged co-investment strategy far exceed the likely gains of investing in any one corporation or specialized laboratory.



Transportation is increasingly a multi-disciplinary field. Advances, such as ITS, and institutional changes resulting from ISTEA and the CAAA necessitate research and education efforts in engineering, planning, and the social and behavioral sciences. The university community offers a unique environment where each of these specialties may be brought to bear on specific transportation issues and research problems. Moreover, the "business" of universities is the creation of new knowledge and *education*. DOT views the capacity of universities to assist the Department in education as integral to its mission of promoting transportation and ensuring that there is a well trained work force available to the transportation enterprise.

In addition to providing a mechanism for co-investment and education, universities are able to provide a vital bridge to all transportation stakeholders. For example, universities conduct considerable research on projects funded by the freight community and local governments. The Department's work with universities thereby provides another means by which DOT learns of specific issues that may impact transportation, but that are not yet a major focus of the Federal Government.

### ***Near Term Efforts***

The near-term efforts in this area include the continued support and management of the University Transportation Centers Program, University Research Institutes; National Highway and Transit Institutes; Dwight David Eisenhower Transportation Fellowship Program; State Planning and Research Program; and the Small Business Innovation Research Program.

#### *University Transportation Centers Program*<sup>20</sup>

FY	1997	1998	1999
Funding	12,000 <sup>21</sup>	12,000 <sup>22</sup>	NA
FTE	NA	NA	NA

DOT's University Transportation Centers Program (UTCP) represents a major investment in fostering transportation innovation and in developing human capital on a variety of transportation issues in its nationwide network of universities. The UTCP was established in 1987 and is managed centrally, with funding provided by both highway and transit titles of ISTEA. The Federal funds are matched by sources such as industry, the universities, and State and local governments. Funded by FTA and FHWA and managed by RSPA, the program's

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<sup>20</sup>The UTC Program funded through FHWA and FTA, and is classified as a System Assessment activity (see discussion in Section III, Chapter 1).

<sup>21</sup>\$6,000k under FHWA budget, \$6,000k under FTA budget.

<sup>22</sup>\$6,000k under FHWA budget, \$6,000k under FTA budget.

missions are to strengthen education, research, and technology transfer of transportation knowledge and skills by addressing regional and National transportation needs. A minimum of 5 percent of each UTC's total funding is dedicated to technology transfer.

Ten university consortia were competitively selected in 1988, 1 in each of the 10 standard Federal regions. In the current program, each center has a lead university and additional participating universities. By the end of its fifth year, the program encompassed a total of 63 universities (including 7 minority institutions) and involved more than 1,400 students and faculty. The ten regional centers were recompeted for the last three years of the authorization (FY 95-97). Three additional National centers were established by DOT in 1992 as a result of ISTEA. The new UTC's are: 1) the National Center for Transportation Management, Research, and Development at Morgan State University in Baltimore, 2) the National Rural Transportation Study Center at the University of Arkansas in Fayetteville, and 3) the Center for Transportation and Industrial Productivity at New Jersey Institute of Technology in Newark.

Education, research, and technology goals received strong affirmation as Congress extended the program for six additional years. Evaluation of proposals and selection of programs for future years are currently in progress.

*University Research Institutes*<sup>23, 24</sup>

FY	1997	1998	1999
Funding	6,250	6,000	NA
FTE	NA	NA	NA

ISTEA also established the *University Research Institutes (URI)* program, which is also managed centrally for the Department by RSPA but funded by FHWA. The intent of the program is to provide centers of excellence in transportation research. The Institutes include the following: 1) a National Surface Transportation Policy Studies Institute based at San Jose State University; 2) an Infrastructure Technology Institute, based at Northwestern University; 3) an Urban Transit Institute, based at both North Carolina A&T University and the University of South Florida as lead of a consortium of Florida universities; 4) an Institute for IVHS Concepts, based at the University of Minnesota's Center for Transportation Studies, which is

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<sup>23</sup>The URI program is classified as a System Assessment activity.

<sup>24</sup> President Clinton's proposed *National Economic Crossroads Transportation Efficiency Act (NEXTEA)* would consolidate and modify the University Research Institutes and the University Transportation Centers programs. It would continue the ten regional university transportation centers. The current array of national centers and institutes, each of which concentrates on a particular transportation issue specified in statute, would be consolidated into a single system.

managed by FHWA in conjunction with other ITS Regional Centers of Excellence; and 5) an Institute for Transportation Research and Education based at the University of North Carolina.

Together the UTC's and URI's will help attract quality students toward careers in transportation, and will facilitate communication between state DOT's and other transportation organizations. In addition, they will provide effective technology transfer of research resulting from efforts at the Centers and Institutes.

The major fiscal year 1998 objectives are to continue to fund promising research efforts that represent advances in surface transportation. Research projects are chosen after funds are granted to the member institutions.

### *ITS Research Centers of Excellence*

FHWA R&D has three competitively selected and one Congressionally mandated Research Centers for Excellence (RCEs) established to provide ITS research solutions, promote ITS technologies, and provide professional development to prepare ITS professionals to design, build, and operate intelligent transportation systems. These are located at the University of Michigan, Texas A&M, Virginia Polytechnic Institute and State University, and the University of Minnesota. Recent major accomplishments of these institutions are wide-ranging, and include:

- Research in Commercial Vehicle Operations involved the application of Automated Vehicle Location (AVL) systems to snow and ice removal and the extension of AVL systems to include dynamic route guidance for vehicles in a time-sensitive (e.g., Just-In-Time) delivery environment.
- One center developed and implemented in the field a first-generation real-time multimodal traffic adaptive control system.
- One center has developed and demonstrated a Wide-Area Incident Management Software System (WAIMSS) as well as point diversion modules, which is scheduled for use in the new Suffolk, Virginia Traffic Management System (TMS) in 1997.
- Center researchers have developed and fabricated optical fiber-based sensors for vehicle (i.e., cars and truck) classification, weigh-in-motion, and visibility condition classification.
- RCE researchers have developed and tested sensor and communication technology, including a wireless digital communication receiver, ultra-wide band communications,

and a passive acoustic sensor for vehicle detection, position location, and automated control.

### *National Maritime Enhancement Institutes*

In 1990, the Maritime Administration designated four universities as National Maritime Enhancement Institutes in recognition of their ability to provide leadership in solving problems confronting the maritime industry. The designation of Institutes was authorized under Public Law 101-115 (authorizing appropriation for fiscal year 1990 for the Maritime Administration). The four Institutes are the University of California at Berkeley, the Louisiana State University, the Massachusetts Institute of Technology, and Memphis State University.

The University of California was designated for technology research relating to the maintenance and operation of shipping fleets including human factors issues. The Louisiana State University chooses to be known as the Institute for Maritime Transportation Systems Research. The Massachusetts Institute of Technology designation was made to the DOT Region I University Transportation Center at MIT for the full range of activities authorized by the legislation. The Memphis State University together with the University of Tennessee and the University of Kentucky are known as the Inland Waterways Studies Institute. Each of the Institutes is either part of a regional DOT University Transportation Center or is part of a university consortium with multimodal, multidisciplinary research capabilities.

No funding is available for the administration of the National Maritime Enhancement Institutes. The fiscal year 1998 objective for the Institutes is to provide a resource for the implementation of the funded Maritime Administration research program.

### *National Cooperative Highway Research Program*

The NCHRP is a unique applied research program designed to respond to the needs of the state highway and transportation departments by solving important operation problems in highway transportation. NCHRP resources are a combination of state voluntary contributions of 5.5 percent of their Federal apportionment of planning and research funds. The NCHRP is administered by TRB under a three-party agreement between FHWA, National Academy of Sciences (NAS) and AASHTO. Since its inception in 1962, the NCHRP has administered 789 research projects with total funding of more than \$149 million. The NCHRP's close association with AASHTO and its position within the National Research Council have enabled the program to carry out many important research tasks resulting in practical products used by state highway agencies and others.

Major activities planned for fiscal year 1998 include:

- Through AASHTO, solicit and administer research on behalf of the various State departments of transportation to address commonly shared problems.

- Support ongoing projects for state-of-the-practice reports, legal histories on topical issues, IDEA topics, international information sharing, and concerns affecting the administration of State departments of transportation.
- Prepare various guidance documents on multimodal transportation planning, geographic information systems, traffic control devices for the aging driver, impacts of economic trends on transportation, implementation of transportation control measures, and HOV (high occupancy vehicle) systems.
- Develop models for determining carbon monoxide concentrations at intersections and vehicle emissions.
- Make significant research contributions to the Highway Capacity Manual for the year 2000.
- Support the implementation of SHRP products, primarily SUPERPAVE, through additional research.
- Develop a strategic plan for roadside safety research.
- Produce several training programs on construction activities.
- Support activities for implementing a new philosophy in bridge design.
- Produce a design catalog for pavement types.

*Transit Cooperative Research Program (FTA)*<sup>25</sup>

FY	1997	1998	1999
Funding	8,250	8,250	NA
FTE	NA	NA	NA

The TCRP is an important component of the Federal Government's support of transit innovation. Since it was authorized in 1961 by ISTEA, the TCRP has been producing a continuing flow of research results of significant importance to the transit industry, which is directly involved in identifying and prioritizing TCRP research projects. The TCRP emphasizes developing near-term research solutions that address immediate, practical needs, providing funds to solve contemporary problems and develop needed improvements in the efficiency and safety of transit operations, customer service, assessment of transit's benefits

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<sup>25</sup>The TCRP is classified as a System Assessment activity.

and economic impacts, marketing, maintenance, management practices, human resources development, and planning techniques.

The TCRP fosters increased cooperation among Federal, state, local and private sector research organizations in the transportation field, improving communications and facilitating technical information transfer. Participants include members of the transit community and researchers throughout the Nation. The TCRP Oversight and Project Selection Committee (TOPS), an independent governing board, develops a research and demonstration agenda for TCRP that is responsive to the needs of the transit industry. The Transportation Research Board administers the program, convening expert technical panels to define the scope of projects, evaluate proposals and guide projects through completion. The American Public Transit Association ensures that research results are widely disseminated to the transit industry.

The TCRP serves as an important, broad-based complement to FTA national R&D programs, which must be more narrowly focused on a limited number of nationally significant innovations. The TCRP fosters greater cooperation among transportation providers and suppliers, State and local agencies and other key segments of the industry in conducting problem-oriented research relevant and useful to the industry. TCRP meets the near-term research needs of the transit industry by consolidating, focusing and strengthening research directly responsive to the day-to-day operational problems of transit.

*Dwight David Eisenhower Transportation Fellowship Program (FHWA)<sup>26</sup>*

FY	1997	1998	1999
Funding	2,000	2,000	NA
FTE	1.0	1.0	NA

The Dwight David Eisenhower Transportation Fellowship Program was authorized by ISTEA in 1991. Its purposes are to attract the Nation's brightest minds to the field of transportation, to enhance the careers of transportation professionals by encouraging them to seek advanced degrees, and to retain top talent in the transportation community of the United States. The program encompasses all areas of transportation and awards fellowships to students and faculty members from colleges and universities across the United States.

The Eisenhower Transportation Fellowship Program awards five fellowships: Graduate Fellowships, Grants for Research Fellowships, Historically Black College and Universities (HBCU) Fellowships, Hispanic Serving Institutions (HSI) Fellowships, and Faculty Fellowships. The Program has a Tribal Colleges Initiative whose purpose is to identify transportation activities at tribal colleges in order to provide fellowships for Native American students and faculty. The Program is administered by the National Highway Institute in the

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<sup>26</sup>The Eisenhower Transportation Fellowship Fund is classified as a Physical Infrastructure activity.

Federal Highway Administration and provides a critical investment in advancing, improving, and maintaining technical expertise in the transportation community.

In fiscal year 1998, the Program expects to award fellowships to over 120 students and faculty members, including at least four fellowships to Native American students and faculty members.

*State Planning and Research (FHWA)*<sup>27</sup>

FY	1997	1998	1999
Funding	80,367 <sup>28</sup>	80,367	NA
FTE	NA	NA	NA

Individual states and FHWA cooperate in the support of highway R&D through the State Planning and Research (SP&R) Program. States receive 2.0 percent of their total Federal-aid highway apportionment as SP&R funding to be used for conducting highway planning and research activities. State highway agencies allocate the SP&R funds between planning and research. In FY 1997, states will spend about \$80 million of SP&R funds for research, development, and technology transfer activities. States also have an option to pool their SP&R and other available funds in nominal amounts to sponsor National and regional cooperative studies of common interest and concern.

Major activities for fiscal year 1998 include the completion of state research on quality assurance in highway design, construction and maintenance, improving traffic control devices, countermeasures to address bridge pier scour, and improving pavement drainage.

*Small Business Innovation Research Program*

The Small Business Innovation Development Act of 1982 (P.L. 97-219), reauthorizing legislation (P.L. 99-443), and Small Business Research and Development Act (P.L. 102-564) seek to encourage the initiative of the private sector and to use small and minority-owned businesses as effectively as possible in meeting Federal R&D objectives. To comply with the statutory obligations of the Act, DOT has established a SBIR Program which conforms to guidelines and regulations provided by the Small Business Administration (SBA). Annually, small businesses are solicited to submit proposals for innovative research that address high-priority requirements of the Department and have the potential for commercialization. The

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<sup>27</sup>The State Planning and Research Program is classified as a Physical Infrastructure activity.

<sup>28</sup>As discussed in the text, this funding (and that for FY 1998) represents a 2.0% set-aside of State Federal-aid highway apportionments.

activity is funded by the DOT operating administrations, and by statute has to be a given a percentage of the Department's extramural research budget.

The DOT SBIR Program is managed by the John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts. The Volpe Center develops integrated systems approaches to critical transportation issues, particularly those that cut across multiple modes of transportation. Its unique role as a multimodal center assures that it will direct the DOT SBIR Program to stimulate technological innovation by inviting small businesses to submit research proposals that address high priority research issues confronting transportation. In FY 1996, SBIR awards were made in a number of surface transportation research areas, including:

Phase I Awards (6 Months)

Energy Absorbing Utility Poles  
Material for Composite Bridges  
Basalt Fiber Reinforced Concrete  
High-Speed Composite Flywheels  
Internet-Based Highway Capacity Software  
Intermodal Operations Planning System

Phase II Awards (24 Months)

Transportation GIS Model  
Vehicle Axle Detectors  
Fatigue Crack Detection  
Transit Decision Support System  
Advanced Traffic Enforcement Technology  
Dynamic Intrusion Sensing System

The Department's SBIR Solicitation for FY 1997, available in hard copy or through the internet, closed for receipt of proposals on May 1, 1997, but was available for access electronically through the World Wide Web (WWW) site maintained by the Volpe Center (<http://www.volpe.dot.gov>). Priority research topics for surface transportation include, but are not limited to the following:

- Portable Microwave System for Measurement of Fatigue Cracks
- Incorporating Remotely Sensed Data in the Transportation Planning Process
- Portable Sensor for Accurate Speed Measurements
- Development of Breakaway Guy Wires for Utility Poles
- Vehicle-Based Animal Deterrent
- Pavement Ice Sensors
- Feasibility of Vehicle Borne Detection of Broken Rail
- Turnout Improvements for Enhanced Safety
- Inspection/Test Method for Finding/Sizing Crack Type Defects in Railroad Tank Cars Covered with Insulation or Thermal Jackets
- Improved Knuckle Coupler with Air and Electric Connections
- Safety Intrusion Detection Devices - Transit Applications
- Improved Maintenance Techniques Linked to Capital Development
- Transit Fare Collection Decision Models for Fare Policy and Cost Analysis
- Unobtrusive Eyelid Closure and Visual Point of Regard Measurement Device
- School Bus Interior Flame Retardant Materials
- Application of Advanced Technology to Reduce Driving While Suspended
- Automated Crash Scene Documentation



Consistent with NSTC recommendations for transportation-related strategic focus areas for the SBIR, the Department is considering the following topics, among others, for its FY 1998 SBIR Solicitation: composite-bonded aircraft structures inspection; systems assessment and modeling of interface environments; crack detection in bridges using remote sensing; and concrete-composite material manufactured from recycled plastics. The final solicitation will be built upon both these recommended research areas and the emergence of priorities in other areas.

## CHAPTER 8

### DOT R&D FACILITIES AND ADMINISTRATIVE SUPPORT FOR R&D

In order to carry out its responsibilities for the management of DOT-funded R&D, and the actual implementation of a number of key activities, the Department devotes a portion of its funding and personnel to administration of these resources. Near-term funding and FTE levels devoted to R&D administration are as follows:

Operating Administration	Funding			FTE		
	1997	1998	1999	1997	1998	1999
FHWA <sup>29</sup>	10,026	10,327	NA	NA	NA	NA
NHTSA <sup>30</sup>	12,600	13,082	NA	NA	NA	NA
FRA <sup>31</sup>	2,181	2,283	NA	2	2	NA
MARAD	0	0	NA	NA	NA	NA
FTA <sup>32</sup>	2,223	2,270	NA	NA	NA	NA

In addition, DOT maintains several actual facilities in which it conducts research supporting Departmental missions. Near-term funding requirements associated with maintaining and refurbishing these facilities are as follows:

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<sup>29</sup>Considered a Physical Infrastructure activity (see discussion in Section III, Chapter 1).

<sup>30</sup>Considered a System Assessment activity.

<sup>31</sup>Considered both a Vehicle- and Physical Infrastructure-related activity.

<sup>32</sup>Considered a Human Behavior-related activity.

*Fairbank Building Renovation (FHWA)*<sup>33</sup>

FY	1997	1998	1999
Funding	500	2,000	NA
FTE	0.20	0.25	NA

The objective of this activity is to complete the renovation of the Fairbank Building, which houses a number of laboratories, and office space for FHWA researchers. The first two stages of renovation are now complete, including new rest rooms; elevator; heating; ventilation and air conditioning equipment; as well as renovation of five laboratories (the bituminous mixtures, concrete, corrosion, pavement binders, and photographic labs). The Stage 3 contract is underway. This stage will complete the renovations of all laboratories except for the aerodynamics laboratory.

Work to be performed in FY 1998 includes completion of office space and corridor renovations (including installation of a sprinkler system), renovation of the aerodynamics laboratory, removal of asbestos, provision of handicap access at main entrance, and insulation of exterior walls and attic.

*Vehicle Research and Test Center (NHTSA)*<sup>34</sup>

FY	1997	1998	1999
Funding	799	799	NA
FTE	0.2	0.5	NA

The Vehicle Research and Test Center (VRTC) is the in-house research, development, test and evaluation laboratory for the National Highway Traffic Safety Administration (NHTSA). VRTC provides engineering analysis in support of NHTSA defect investigations and rulemaking initiatives. Long term research programs in the areas of biomechanics, crash avoidance and crash worthiness are also performed at VRTC.

VRTC is located on contractor owned property. The agency leases the building and work areas. All expenses associated with maintenance of the facility are covered by the government via VRTC administrative funds. These include: utilities (heat, sewage disposal, electricity, phone equipment), lease of GSA vehicles, janitorial services, supplies, copier expenses, etc.

VRTC houses over \$2 million worth of specialized test fixtures and equipment. A significant amount of this equipment is ADP and electronics equipment. Calibration, maintenance, replacement and upgrade of this equipment is required on a yearly basis.

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<sup>33</sup>Considered a Physical Infrastructure activity (see discussion in Section III, Chapter 1).

<sup>34</sup>Considered a vehicle-related activity.

Department approval has been granted for a space expansion at VRTC. In response to a request for more space, the contractor has proposed relocating VRTC to a new building at the same location. When this occurs, increased lease and maintenance costs would be expected, as well as relocation costs. Negotiations regarding the design, cost and timing of the relocation are ongoing and nearing completion. A move in FY98 is anticipated.

*R&D Facilities (FRA)*<sup>35</sup>

FY	1997	1998	1999
Funding	420	850	NA
FTE	1	1	NA

This program area is intended to protect the Government's capital investment in facilities and equipment at the Transportation Technology Center (TTC) in Pueblo, Colorado. A world-class proving ground for railroad equipment, the government-owned TTC represents a facility capital investment of over \$200 million. While the facility is operated for FRA under a no-cost contract with the Association of American Railroads (AAR), the AAR is only required to provide routine maintenance for buildings and equipment. The R&D Facilities Program is therefore essential for sustaining the viability of TTC's research capabilities by continuing to replace or refurbish facilities or equipment that can no longer be economically maintained by AAR. Current activities include environmental law compliance and R&D facilities restoration. Environmental Law Compliance includes completing construction of new wastewater treatment facility. R&D Facilities Restoration includes:

- Completion of upgrade of Railroad Test Track to permit 150 mph testing of Amtrak's Northeast Corridor trainsets.
- Completing post-closure groundwater monitoring in wells at solid waste management units.
- Upgrading electrical equipment in DC substations.
- Replacing servo-controllers on the Simuloader in the Rail Dynamics Laboratory.
- Installing heavier running rail on approximately two miles of 3rd-rail DC-powered test track to allow testing of dual-mode locomotives.

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<sup>35</sup>Considered both a Vehicle- and Physical Infrastructure-related activity.

New initiatives scheduled for FY 97 include:

- Rebuilding a trueing machine that enables railroad car steel wheels to be reprofiled without dismounting from truck assembly;
- Installing heavier running rail on approximately 2 miles of 3rd-rail test track to enable testing of dual-mode locomotives;
- Upgrading on-site ambulance support; and
- Re-roofing rectifier substation #2.

Ongoing projects include the complete restoration of all solid-waste management units.

Key FY 1998 milestones will include:

- Initiation of testing of Amtrak's Northeast Corridor trainsets.
- Upgrading emergency vehicles used for ambulance and firefighting support services.
- Re-roofing three buildings used for secondary support facilities.

## SECTION IV. CONTRACTING PROCEDURES

Section 6009(b)(3)(C) of ISTEA calls for:

*Recommendations on changes needed to assure that Federal, State, and local contracting procedures encourage the adoption of advanced technologies developed as a consequence of the research programs in this Act.*

Experience has shown that Government contracting procedures significantly impact the adoption of advanced technologies. While it is understood that many traditional procedures (e.g., low-bid contracting with performance specifications) are in place to reduce risk, protect investments, and ensure accountability, at times such traditional procedures have the dual effect of discouraging innovation and failing to support the overall purpose of reducing life cycle costs through improved performance and durability.

As an example, current highway regulations facilitate separation of design from construction, primarily to obtain as much competition as possible during the highest cost phase of construction programs. This process also opens more opportunities to small and mid-sized construction firms which may not have architectural and engineering capabilities. By adding another party and step to the acquisition process, however, the procedures raise questions of contract performance and product liability responsibilities whenever new or unusual designs or construction technologies are attempted. Local government buyers tend to avoid "unnecessary" risks until innovations are thoroughly tested and available on the open market.

In responding to ISTEA's call for contracting procedures that promote advanced technologies, the Department is committed to determining which practices impede innovation and the alternatives or incentives that are available to encourage the use of innovations. The October, 1994 Acquisitions, Reengineering, and Realignment Task Force (ARRTF) studied DOT's contracting and acquisitions procedures, and recommended ways to streamline the present system.

A number of innovative recommendations have resulted from this process, many of which have been implemented in recent months. The Department's new Re-invention Laboratory is one example of the outgrowth of these efforts. Modeled after other recently established re-invention laboratories within the Federal government, including NASA's, the Lab was created to increase flexibility and innovation in DOT's acquisition processes by allowing freedom, i.e., a waiver, from compliance with various administratively-imposed requirements. This is done primarily through the Agency's implementation and interpretation of the statutes and regulations. As an example, the regulations do not require proposals to be in written form, so oral proposals are now often used. With the Re-invention Lab, DOT now also has a means for experimenting with pilot programs for re-engineered processes. Among the issues the Re-invention Lab addresses include: establishing performance measurements and standards to

assess the success of pilot programs; assessing and managing the risks associated with implementing changes such as greater delegation of authority and reduced file documentation; re-engineering other processes and conducting pilot programs to determine potential benefits; influencing the development of Federal regulation and new procurement legislation; and addressing the multitude of cultural issues in the DOT procurement community.

In addition to these efforts, DOT has increasingly been making use of the flexibility offered by the provisions of ISTEA. This has enabled the use of a number of innovative financing tools including leveraging tools (e.g., flexible match; bonds and debt; ISTEA Section 1021 Loans; ISTEA Section 1044 Toll Investment Credit) and cash flow tools (advance construction; partial conversion of advance construction; phased funding; and tapering) and has promoted the increasingly necessary trend of public/private partnerships.

This chapter discusses a number of these innovative new financing tools, programs, and task force efforts along with an overview of current contracting practices and recent Federal actions on procurement laws and regulations.

### ***Overview of Current Contracting Practices***

Since DOT does not own nor operate surface transportation systems, contracts for all but about 3 percent of federally assisted surface transportation programs will be placed and managed by DOT grantees or subgrantees, such as State, county, and city governments, regional and municipal authorities, special districts, and Amtrak. Of the contracts placed by DOT, the largest dollar amount is for building and rehabilitating roads in National Parks and Forests. The remainder (only about 1 percent) of the Department's annual surface transportation funds is used for DOT sponsorship of research, development, training, technical assistance, and technology transfer.

In the future, the number of grantees and subgrantees can be expected to increase. More decision making responsibilities have been vested in State and local governments by flexible funding provisions of ISTEA. Nationally, funding emphasis has shifted from completing the Interstate System to maintaining and improving the National Highway System, including local highways and access to intermodal facilities. Congestion mitigation, air quality, and regional traffic management systems can be expected to lead to increased involvement of city and county governments and regional agencies.

Through the Intelligent Transportation Systems (ITS) program authorized by ISTEA, the Department has increased its emphasis on using advanced sensing, computing, and communications technologies to improve the productivity of existing infrastructure. ITS developments will undoubtedly lead to increases in the variety and quantity of local procurements of hardware and software. This growing diversity of agencies and products

underscores the need for a continuing effort by DOT to understand the effects of Government contracting practices at all levels.

### *General Requirements for DOT Grantees*

Procurement procedures for State and local governments under grants and cooperative agreements that use Federal funds are set forth in title 49, Code of Federal Regulations (49 CFR, Part 18), "Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments" (the common grant management rule). The rule applies to all grants and subgrants awarded by DOT. Issued in 1988, the rule called for a less intrusive Federal role in grantee procurement activities. It responded to an Executive Order directing Federal agencies not to substitute their judgment for that of the recipient unless the matter is primarily a Federal concern, and that agencies, to the maximum extent feasible, defer to the States to establish standards, rather than setting National standards.

The common grant management rule prohibits Federal agencies from imposing additional administrative requirements, unless required by statute, and encourages grantees to avoid detailed or burdensome application requirements for subgrants. A key provision is that States are to follow the same policies and procedures they use for procurements using non-Federal funds. However, the procurements must conform to applicable Federal law. Grantees and subgrantees are to follow the provisions of Part 18 and use their own procedures reflecting applicable State, local, and Federal laws. Procurement transactions are to be conducted in a manner providing full and open competition. While this rule covers the majority of grantees, the States are authorized to follow their own procedures used for procurements from non-Federal funds. Noncompetitive procurements are permitted only under exceptional circumstances.

49 CFR Part 18 invokes Federal laws that apply to contracts awarded under any federally financed program. Examples are: Equal Opportunity Employment, Anti-kickback, Clean Air, Clean Water, and Davis-Bacon. For the convenience of State and local government grantees, and to assure universal application, FHWA requirements specify use of a uniform contract attachment. FTA lists laws and regulations which apply specifically to transit programs in its master agreement.

The grant management rule for universities and other not-for-profit institutions is 49 CFR Part 19.

### *Federal Aid Highway Programs*

The objectives of highway design and construction contracting procedures are to minimize costs and risks, obtain essential uniformity in nationwide highway systems, and accelerate the rate of new construction nationally. In addition to the common grant rule, 23 CFR Parts 172, 633, and 635 provide detailed contracting procedures and forms for engineering and design



contracts and for construction contracts. For engineering and design contracts, the regulations permit any form of competitive negotiation that uses qualification-based procedures. For highway construction, the regulations require low-bid procedures.

The regulations have been undergoing evaluation and refinement since the Federal-aid Highway Program began in the 1950s. They have been modified to respond to changes in National policies and laws and have been continuously tested by litigation. As was mentioned earlier, highway regulations facilitate separation of design from construction, primarily to obtain as much competition as possible during the highest cost phase of construction programs; a process that also opens more opportunities to small and mid-sized construction firms which may not have architectural and engineering capabilities. This additional step to the acquisition process, however, raises questions of contract performance and product liability responsibilities whenever new or unusual designs or construction technologies are attempted. In turn, risk-averse local government buyers tend to avoid "unnecessary" risks until innovations are thoroughly tested and available on the open market, and at competitive cost.

FHWA is able to use the greater flexibility of its R&D and demonstration programs to develop and test new construction technologies, materials, and processes. FHWA grantees are encouraged to participate in advanced technology programs through the NCHRP and the agency's R&D and special experimental projects. The special experimental projects include evaluating innovative contracting practices such as cost-plus-time bidding, lane rental, design-build contracting, and warranty clauses.

### *Building Partnerships with Innovative Financing*

With current constraints at the Federal level, Federal funding in many programs will undeniably be limited in the future. Coupled with this, State and local governments are under similar constraints and face competing demands for various vital needs. The best response to this may likely be the new trend toward partnerships with the private sector. Many of the United States' international competitors already employ this tactic.

In January of 1995, President Clinton announced the "Partnership for Transportation Investment." Also known as "Innovative Financing," the term covers a broad range of strategies including the use of leveraging and cash flow tools. DOT's involvement with Innovative Financing began with provisions in ISTEA that allowed experimentation with varied ways of financing advanced technology projects. Over the last three years, DOT has aggressively pursued such experiments.

Many such projects employ single financing techniques, while others combine techniques to obtain the greatest benefits from the flexibility allowed under such programs as the FHWA's Test and Evaluation 045 (TE-045) program (a program which allows for the testing of many of the Innovative Financing ideas generated). Incentives for using Innovative Financing, and ones which have been realized, include the ability to complete projects more quickly as well as

the opportunity to begin more projects. Moreover, Federal dollars have leveraged additional dollars and private investment in infrastructure has grown.

The primary goals of Innovative Financing are to: create incentives for the States to take full advantage of ISTEA's financing opportunities; to learn what new financing strategies and policies work best and make necessary changes; to assist the States in their efforts to leverage their current funding and produce additional funds - both public and private; and to move projects into construction more quickly than under traditional financing procedures.

Innovative Financing, working within the existing statutory framework, allows many of the existing restrictions and requirements to be waived and gives local decision makers greater flexibility and authority. Such experimentation is critical in that the current system of paying for projects only through grant reimbursement is increasingly being considered outdated; the "red tape" required slows projects and increases costs, making it difficult for States and localities to involve private investors.

These innovative financing tools, designed to make more funds available to transportation providers, include leveraging tools such as: Flexible Match; Bonds and Debt; ISTEA Section 1012 Loans; and ISTEA Section 1044 Toll Investment Credits. Other innovative tools used, referred to as cash flow tools, include: advance construction; partial conversion of advance construction; phased funding and tapering.

As an example of *Flexible Match*, the Maine Department of Transportation is constructing an intermodal truck-to-rail transfer facility near the Town of Fairfield. Located about one mile from the Interstate, the facility will provide for the transfer of truck freight from major U.S. highways to key rail lines, both in Maine and throughout New England. Under the Innovative Financing effort, a private rail company is contributing material, equipment, and services for use in the project. The State is crediting the value of the rail contributions toward the State's share of project costs. The rail contribution saves the State \$1.57 million, which can be used elsewhere for transportation.

*Bond and Debt Financing* is demonstrated by the Conway Bypass project in South Carolina. The South Carolina DOT plans to build a link between U.S. 17 and other major roads that lead to the Grand Strand/Myrtle Beach area, increasing access to the State's largest tourist area. FHWA is applying the TE-045 ISTEA Section 1012 loan approach to a non-toll facility with a dedicated revenue repayment source. This loan for the estimated construction cost of the project provides cash to service the bonds supporting the project. Bond principal and interest on the project will be repaid using TE-045 flexibility. By combining Innovative Financing and innovative contracting, this project is expected to save over \$100 million, with construction accelerated by 20 years. Local sales tax revenues will also fund a portion of the project.

As an example of the *ISTEA Section 1012 Loan*, the Texas Department of Transportation has constructed an 8-lane bridge and supporting facility between Laredo, Texas and Nuevo

Laredo, Mexico. The project includes a loan of \$11 million from the State to the City of Laredo. The loan financing the bridge, which is expected to cut congestion brought about by the increased traffic expected from NAFTA, will be paid for by toll revenues and rental income from other users of the facility.

The Maryland Department of Transportation used *Section 1044 Credits* earned from toll revenue expenditures to make needed highway capital improvements. Under an innovative approach to the Section 1044 Maintenance of Effort requirement, the State has used about \$18.9 million in toll credits in FY 1995 based on a prospective Maintenance of Effort test. State credits will be used as the State share for funds on the I-70 project near Frederick, Maryland among others. This frees up State funds (which may otherwise have been required to meet matching requirements) for use on other projects.

The Butler County Highway in Ohio is an example of using *Advance Construction*. The Ohio DOT will construct a four-lane, 10.3-mile road and extra lanes on the Interstate to accommodate a proposed interchange. The project, which costs \$95 million, is based on State legislation that established a transportation improvement district in the area. Because of the good prospect of future Federal funds, the State can borrow more easily to finance the project and, as a result of Advance Construction eligibility and flexibility, the State can obtain better financing for an intergovernmental loan and/or private bonds for the project.

Interstate route improvements in Pennsylvania, including three major reconstruction projects along high-volume interstates and expressway routes, are currently being financed through *Partial Conversion of Advance Construction* funds. The Federal share of all three projects is approximately \$45 million. The State will partially convert Advance Construction projects, saving as much as 5 percent of the State's FY 1995 obligational authority and making it possible to advance other "ready-to-go" projects earlier in the authorization period.

In New Jersey, a new viaduct will be constructed and three bridge decks replaced using *Phased Funding*. In this way, the State can spread costs over two years and make more efficient use of Federal funds, enabling the project to begin a year early. Phased Funding will enable several other bridge replacement-eligible projects which might otherwise have been delayed six to eight months to be obligated at a significantly faster pace.

The Michigan DOT has utilized *Tapering Non-Federal Matching Shares* in their recent widening of a State truck line aimed at increasing capacity to alleviate congestion problems. The project costs for Phase II are approximately \$70 million with authorized Federal participation of \$57.3 million. Tapering will enable Michigan to achieve better cash flow management during the riskier early project stages.

On November 28, 1995 Congress enacted P.L. 104-59, the National Highway System Designation Act of 1995. Sections 311, 313, and 322 of this Act take innovative financing one step further by making permanent the financing technology demonstrated under TE-045.

In addition, Section 350 established a 2-year State Infrastructure Bank (SIB) Pilot Program that will allow States to recycle transportation funding and leverage additional investment in transportation infrastructure over a long-term period. The Department views the SIB Pilot as a means of advancing a multiple financing strategy.

While many of the early projects utilizing Innovative Financing have been ones to build new roadways, other modes, including transit, rail, and aviation, have high potential. For example, airport construction, which relies on the capital markets for as much as three-quarters of its funding, has long been a model for involving the private sector in public projects.

As an example, Northern Southern Railroad recently paid to add a third track on a rail right-of-way in Cincinnati, greatly reducing rail congestion. The Railroad will be reimbursed for this over time through the State's ISTEA allocation using Advance Construction Funding.

Three FTA grantees, the Chicago Transit Authority (CTA), the Bi-State Development Agency (Illinois and Missouri) and New Jersey Transit (NJT), recently concluded innovative financing transactions that together generated nearly \$57 million dollars in additional transit revenues. All three are U.S. tax-based transactions involving U.S. taxpayers. While the transactions confer certain tax deferment and depreciation benefits, they will nonetheless be "tax-positive" to the Treasury, and earn approximately \$65 million as a result. The CTA entered into a U.S. leveraged sale/leaseback ("Pickle" lease) of approximately \$831 million in rail cars. CTA transferred title to the vehicles to a private investor, and will lease them back over a 20-year period. The CTA has received approximately \$47 million in profits. Bi-State concluded a similar Pickle lease of \$59 million in rail cars, and received \$3.8 million in profit. NJT closed a Pickle lease of some \$125 million in locomotives and rail cars, and received \$6 million in profit. The lease terms allow the grantees to maintain control and use of the equipment in mass transit service, as required by Federal law. They regain title to the equipment at the end of the lease period.

#### *Transit Equipment and Construction Contracts*

Although DOT-assisted transit programs follow the common grant management rule, FTA maintains a circular, (C 4220.1D, "Third Party Contracting Requirements") to assist grantees and regional offices in interpreting the procedures that are specifically applicable to transit agency procurements. The circular and its referenced laws and regulations emphasize that all procurement transactions are to be conducted in a manner providing full and open competition. In addition, 49 USC 5323(h) and 49 USC 5307(d)(1)(E), formerly sections 3(a)(2)(C) and 9(e)(3)(E) of the Federal Transit Act of 1964, as amended, forbid the use of Federal grant or loan funds to support procurements utilizing exclusionary or discriminatory specifications.

However, grantees are encouraged to use "value engineering" clauses and may use procurement by competitive proposals in lieu of sealed bids. (Value engineering clauses cover situations where a contractor comes up with an idea, after the work has begun, that saves

money. The clause, most often utilized in construction projects, allows for the contractor and government to share the savings.) The competitive proposal method allows consideration of such factors as technical risks, life cycle costs, technical performance, and management approach, as well as initial costs. However, because of State and local regulations most authorities continue to rely on definitive specifications and low-bid contracting, or on low-bids for life cycle costs. Life cycle costs refer to initial and future costs such as maintenance, reconstruction, rehabilitation, restoring, and resurfacing costs over the life of the project.

Unlike the high-volume construction programs of FHWA, most new rail starts, busways, downtown people movers, and urban rail modernization programs have been acquired as systems with contracts tailored individually for the unique circumstances of each project. For purposes of programmatic or technical approvals, major transit programs are often divided into phases; however, separate contracts for design and construction contracts are not required. A variety of design-build methods have been used by transit authorities, including turnkey projects.

On May 7, 1996, FTA launched the publication of the *Best Practices Procurement Manual*. This Manual provides recipients of FTA funds suggestions on conducting third party procurements to assist them in meeting the standards of FTA Circular 4220.1D. The Manual consists of suggested procedures, methods, and examples which FTA encourages. These are based on the Federal acquisition process, Comptroller General decisions, and "Best Practices" of grantees and others in the industry. The Manual is envisioned as an ongoing and expanding document. It will be updated periodically with both new subjects as well as additions or changes to existing subjects. The additions/changes will be based on: (1) changes in statutes, (2) the result of recent court decisions, (3) the need for further clarification, and (4) new or innovative practices of grantees. The Manual is located on the Internet World Wide Web under the FTA Homepage. The internet location enables FTA to provide its customers with the latest and newest information using the fastest means possible. Additionally, FTA solicits "best practices" of its grantees and others in the industry. After review by FTA, new and or innovative practices will be added to the manual.

### *Acquisitions by DOT*

All DOT organizations that acquire supplies and services are governed by DOT's Transportation Acquisition Regulation (TAR) and Transportation Acquisition Manual (TAM) that implement and supplement the Federal Acquisition Regulation (FAR).<sup>36</sup> Together these documents provide a detailed set of rules governing all phases of acquisition, including procedures to contract for all products and services, including R&D.

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<sup>36</sup>Section 348 of the Department of Transportation and Related Agencies Appropriations Act, 1996 (Pub. L. 104-50) exempts the FAA from many governmentwide procurement statutes and regulations.

In addition to contracts, DOT employs more flexible cost-shared vehicles like Broad Agency Announcements (BAAs), grants to research institutions, cooperative agreements, other transactions, and Cooperative Research and Development Agreements (CRADAs) to leverage the limited R&T resources available. While the use of CRADAs had been somewhat limited in the past, the FAA - among other modes - has been quite active in using these agreements as the benefits of using them are increasingly realized. CRADAs are cost-sharing vehicles that, through encouraging early industry buy-in, ultimately promote the development of commercially viable products and services. The public and the Department have benefitted considerably from the results of long-standing cooperative research programs with universities, industry and professional associations (e.g., AASHTO, AAR, APTA), and the Transportation Research Board of the National Research Council.

### *Contracting in the Electronic Age*

DOT has increasingly been using such tools as the Internet to both ease and expedite many of the government's contracting and grant procedures. From posting information ranging from university research grants to contract solicitation and award, the Internet is increasing accessibility and, in many ways, promoting the advanced technologies aspired for with the passage of ISTEA.

Among the vast grant- and contracting-related items that are housed on the Internet are: experimental university R&D programs; university transportation-related R&D grants; grant management requirements; contract solicitations and awards; and information on the uses of DOT contracts, grants and cooperative agreements, among other items. With such information readily accessible, the government has essential access to current university and private sector research, enabling both better and quicker assessment of available research and technologies. At the same time, the Internet provides universities and the private sector access to the latest information and opportunities in DOT's contracting and grant environments.

In a climate where it is increasingly felt that federally-sponsored research and development should be pushed toward cooperative funding, the Internet--by increasing information flow--is enhancing the opportunity for such partnerships. For example, the Department's two most recent SBIR Program Solicitations both were made available on the World Wide Web (WWW) site for the Volpe National Transportation Systems Center.<sup>37</sup> Many other DOT RFPs and CBD notices are available through the Department's WWW site,<sup>38</sup> and a wealth of procurement information can be accessed via the Small Business Administration (SBA) WWW site.<sup>39</sup>

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<sup>37</sup>The site address is <http://www.volpe.dot.gov>. The closing date for the FY 1997 solicitation was May 1, 1997.

<sup>38</sup><http://www.dot.gov>

<sup>39</sup><http://www.sbaonline.sba.gov>

Other items on the Internet that have enabled DOT's contract and grant information to reach a wider audience are the posting of such items as: Executive Orders; various recent rules and regulations changes that affect the grant and contracting environment; and contract reporting requirements, among others. This has been a significant benefit in that all modes now have a common and accessible vehicle to turn to for updated policies and procedures. This has been helpful in setting more uniform standards across the modes.

### ***Recent Federal Actions on Procurement Laws and Regulations***

#### *Federal Acquisition Streamlining Act of 1994 (PL 103-355)*

On October 13, 1994, President Clinton signed the Federal Acquisition Streamlining Act of 1994 into law. Most of the provisions of the Act are being implemented through changes to the Federal Acquisition Regulation. There are over 90 sections of the law that were addressed through that process. Key provisions affecting R&D procurements that are in effect include:

- Clarification of the agency authority to execute multiple-contractor task- and delivery-order contracts. Within DOT, such model processes were pioneered at RSPA's Volpe Center. The Center's multiple contractor resource base (known as the OMNI program) has been used for over eight years to obtain technical support for projects managed by the Volpe Center. This practice has now been adopted by OST on behalf of all operating administrations.
- On acquisitions of less than \$2,500 or 0.1% of total project cost, whichever is greater for Buy America provisions, the requirements to reserve procurements for small business and to comply with provisions of the Buy America Acts have been eliminated.
- Establishment of a Congressional policy that Federal agencies should not be required by legislation to award new contracts or R&D grants to specified non-Federal entities, and that any program, project, or technology identified in legislation be procured through merit-based selection procedures.

When fully implemented and translated into rules, other provisions of the Act will undoubtedly assist in accelerating the adoption of advanced technologies developed as a result of programs authorized by ISTEA.

#### *Federal Acquisition Reform Act of 1996*

On February 10, 1996, President Clinton signed into law the National Defense Authorization Act for Fiscal Year 1996, which contained, in Division D, the Federal Acquisition Reform Act of 1996 (FARA). In general, FARA amends various provisions of the Armed Services Procurement Act, the Federal Property and Administrative Services Act of 1949, the Office of

Federal Procurement Policy Act, and the Federal Acquisition Streamlining Act of 1994 to further streamline the Federal procurement process. Key provisions include:

- Statutory approval thresholds for justifications for other than full and open competition were increased.
- Offerors excluded from the competitive range, or that are otherwise excluded from the competition prior to selection, may request a debriefing prior to contract award.
- FARA provides for a new "two-phase" selection procedures for the design and construction of a public building, facility or work. Under phase-one, only information pertaining to prospective offerors' technical approach and qualifications are solicited; no cost/price or detailed design information are requested at this phase. Phase-two of the competition solicits technical proposals (design concepts and/or proposed solutions), and cost/price information from those offerors selected following phase-one in accordance with the solicitation.
- FARA provides for special simplified procedures for the procurement of commercial items valued between \$100,000 and \$5 million. This authority is in addition to the authority for simplified acquisition procedures authorized by FASA for acquisitions between \$2,500 and \$100,000.
- FARA exempts contracts and subcontracts for the acquisition of commercial items from Cost Accounting Standards.
- The Procurement Integrity Act was amended in its entirety. In general, the certification requirements have been eliminated, and the intentional disclosure by Government personnel, and the intentional acquisition by any person (other than as is provided by law) of bid/proposal, or source selection information prior to award of a Federal contract is prohibited.

#### *49 CFR Parts 18 and 19, The Grant Management Rules*

In April 1995, the Office of the Secretary issued a final rule amending 49 CFR Part 18, raising the dollar threshold for small purchases to \$100,000. The NPRM also proposes to raise the threshold for DOT approval of several grantee agency actions. Although not aimed primarily at stimulating new technologies, the changes are intended to reduce the administrative burden on grantees, and may accelerate the acquisition of studies and expert assistance necessary to introduce technological innovations. With passage of the Federal Acquisition Streamlining Act of 1994, a new simplified acquisition threshold for universities and not-for-profit institutions under CFR Part 19 was set at \$100,000.



### *23 CFR Parts 420 and 511, State Planning and Research Program Administration*

On July 22, 1994, FHWA published a final rule amending these sections to grant States greater responsibility and flexibility for the management and oversight of their research, development, and technology transfer initiatives supported with FHWA planning and research funds. The rule also reflects the requirements in 23 USC 307(c) for research, development and technology transfer activities.

### *23 CFR Part 637, Quality Assurance Procedures for Construction*

On June 29, 1995, FHWA published a final rule that revised its general requirements for quality assurance procedures for construction on Federal-aid highway projects. The revision permits use of contractor testing results in the overall acceptance program and could permit more rapid introduction of advanced construction and testing techniques.

### *Interim Policy Statement on Life-Cycle Cost Analysis (LCCA)*

On July 11, 1994, the Federal Highway Administration (FHWA) published an interim policy statement on life-cycle cost analysis for public comment (59 Federal Register 35404). The interim policy responds to ISTEA requirements to consider life cycle costs in the design and engineering of bridges, tunnels, and pavements. The policy also implements the Presidential Executive Order 12893 of January 26, 1994, "Principles for Federal Infrastructure Investments," that requires benefits and costs to be measured and discounted over the full life cycle of each project. Subparts B and C of the final rule on implementation of ISTEA management systems (23 CFR 500.207 500.307) require use of LCCA for bridge and pavement management systems. LCCA contracting provides an incentive to contractors to adopt new materials and technologies, and monitoring of integrity and prioritization of maintenance, which improve the durability of infrastructure and save costs in the long run.

To support preparation of the policy statement, FHWA and AASHTO held a jointly sponsored symposium in December 1993, to learn more about LCCA practices among States and to identify research, training, technical assistance, and policy-related needs to improve LCCA practices. Issues and research needs identified at the symposium were: how to establish the appropriate analysis period, how to value and properly consider user costs, and how to choose the appropriate discount rate.

Participants in the symposium identified research data needed to predict pavement and bridge performance and forecast future traffic. One significant point brought out was that "...the results of LCCA may favor selection of improvements with higher initial costs in order to achieve significant long-term savings in overall investment requirements. It may indicate, for instance, that more projects warrant reconstruction rather than rehabilitation strategies, that early intervention with preventive maintenance is cost effective, or that somewhat higher designs or levels of service may be appropriate for some facilities." Aside from the important

information gathered at the symposium, offering incentives to encourage use of newest technologies may also promote greater creativity among the States.

Comments on the interim policy statement were submitted in October of 1994. Taking these into consideration, FHWA plans to release a final LCCA policy statement this summer. FHWA will develop training and technical assistance materials to supplement analysis techniques developed by AASHTO in the National Cooperative Highway Research Program.

*Department of Transportation and Related Agencies Appropriations Act, 1995, P.L. 103-331*

Provisions in each of the Department's appropriations acts for fiscal years 1995, 1996, and 1997 authorize the Secretary of Transportation to enter into grants, cooperative agreements and other transactions with any entity in execution of the Technology Reinvestment Project (TRP) conducted by the Department of Defense Advanced Research Projects Agency. The language was necessary because several of the Department's administrations did not have statutory authority to enter into "grants, cooperative agreements, or other transactions" and may be called upon to accept interagency funds transfer, award and manage TRP projects.

*National Highway System Designation Act of 1995*

Under the National Highway System Designation Act of 1995, the Secretary is required to establish a program for Life-Cycle Cost Analysis and Value Engineering Analysis. The Act mandates that the Secretary "establish a program to require States to conduct an analysis of the life-cycle costs of each usable project segment on the National Highway System with a cost of \$25,000,000 or more." Analysis of the life-cycle costs refers to "a process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs such as maintenance, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment."

The Act also states that the Secretary must "establish a program to require States to carry out a value engineering analysis for all projects on the National Highway System with an estimated total cost of \$25,000,000 or more." Value engineering analysis refers to a systematic process of review and analysis of a project during its design phase by a multidisciplinary team of persons not involved in the project. The team's objective is to provide suggestions for reducing the total cost of the project and providing a project of equal or better quality. The outcome of such analysis may include suggestions for combining or eliminating otherwise inefficient or expensive parts of the proposed design for the project or the total redesign of the proposed project using different technologies, materials or methods.

### ***Recommendations Regarding Future Contracting Procedures***

ISTEA reauthorization represents an opportunity to update contracting procedures to encourage the adoption of advanced technologies developed through private and public surface transportation research and development. As is discussed earlier in this report, one of the Department's most important priorities over the next decade will be accelerated widespread deployment of infrastructure for metropolitan and rural areas, and for commercial vehicles.

Although innovative and flexible financing and procurement methods will be essential to the achievement of these and other departmental technology deployment objectives, ingrained state and local transportation agency financing and procurement processes have made the adoption of "true" private/public partnership arrangements difficult. The next surface transportation authorization needs to sanction innovative financing and procurement approaches, including private/public partnerships, State Infrastructure Bank (SIB) financing, electronic payment technologies, design/build contracting, life-cycle cost evaluation, and negotiated bid awards.

In addition, FTA proposes to augment its current R&D authority under 49 U.S.C. 5314 by allowing the Department to enter into grants, contracts, cooperative agreements and other agreements with consortia to promote the early deployment of innovation in mass transportation technology, services, management, or operational practices. The program would be carried out in consultation with the transit industry by competitively selecting public/private partnerships which share costs, risks, and rewards of early deployment of innovation with broad applicability. FTA also proposes the authorization of an International Mass Transportation Program, through which the Secretary would engage in activities to inform the U.S. domestic mass transportation community about technological innovations available in the international marketplace, and in activities that may afford domestic businesses the opportunity to become globally competitive in the export of mass transportation businesses and services.